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Epitome

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(57) [Abstract]
[Technical problem] Washing established piping using the washing refrigerant containing a part for chlorine with an environment top problem has the problem which environmental pollution and washing processing take time amount.
[Means for Solution] The washing station of a refrigerating cycle using the refrigerant which does not contain a part for chlorine is used, and operation of a washing station is controlled to make [many] the refrigerant flow rate supplied to washed piping, to make high temperature of the refrigerant supplied to washed piping, or to become a two phase refrigerant about the refrigerant supplied to washed piping. Moreover, while making piping connection of the washing station with heat souce, transmission of operation information is enabled.

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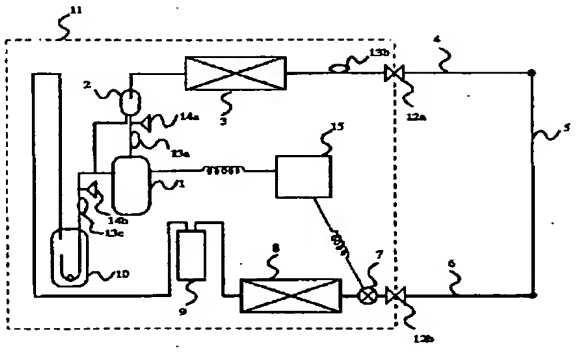

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CLAIMS

[Claim(s)]
[Claim 1] The piping washing station characterized by to have the control unit of the flow resistance of the heat exchange capacity of said condenser, and said expansion equipment, and the heat-exchange capacity of said evaporator which controls any one at least so that a compressor, a condenser, expansion equipment, and an evaporator may be connected and it may become the recovery system which washes the washed body and collects washed objects with the refrigerant conveyed with said compressor, and the desired value as which the physical condition of said refrigerant was determined beforehand.
[Claim 2] Said control unit is a piping washing station according to claim 1 characterized by controlling so that the refrigerant which flows into said washed body serves as vapor-liquid two-phases flow.
[Claim 3] The piping washing station according to claim 1 or 2 characterized by controlling a control unit to become beyond the predetermined desired value as which the low voltage pressure which equips inlet-side piping of said compressor with a low voltage pressure sensor, and is detected by said low voltage pressure sensor was determined beforehand.
[Claim 4] The piping washing station according to claim 1 or 2 characterized by controlling a control unit to become beyond the predetermined desired value as which the high-pressure pressure which equips discharge-side piping of said compressor with a high-pressure pressure sensor, and is detected by said high-pressure pressure sensor was determined beforehand.
[Claim 5] The piping washing station according to claim 1 or 2 characterized by controlling a control unit to become below the predetermined desired value as which the discharge temperature which equips discharge-side piping of said compressor with a discharge-temperature sensor, and is detected by said discharge-temperature sensor was determined beforehand.
[Claim 6] The piping washing station according to claim 1 or 2 characterized by controlling a control unit so that the inhalation degree of superheat computed by the intake air temperature detected from the low voltage pressure which equips inlet-side piping of said compressor with a low voltage pressure sensor and an intake-air-temperature sensor, and is detected from said low voltage pressure sensor, and said intake-air-temperature sensor serves as predetermined desired value defined beforehand.
[Claim 7] The piping washing station according to claim 2 characterized by controlling a control unit to become the predetermined target range where the dryness fraction of the two phase refrigerant computed from the condenser outlet temperature detected from the high-pressure pressure which equips discharge-side piping of said compressor with a condensation outlet temperature sensor at outlet side piping of a high-pressure pressure sensor and said condenser, and is detected from said high-pressure pressure sensor, and said condensation outlet temperature sensor was defined beforehand.
[Claim 8] The piping washing station according to claim 1 or 2 characterized by preparing the high low voltage heat exchanger which carries out heat exchange of a part or all of the heat of condensation of a refrigerant that is obtained with said condenser as evaporation heat in an evaporator.
[Claim 9] The piping washing station according to claim 8 characterized by changing the amount of heat exchange of a high low voltage heat exchanger so that the physical condition of said refrigerant may serve as desired value defined beforehand.
[Claim 10] The piping washing station according to claim 8 characterized by having a gas cooling means to cool the refrigerant which flows out of said high low voltage heat exchanger, and which evaporated, and changing the refrigeration capacity of said gas cooling means according to the physical condition of said refrigerant.
[Claim 11] The piping washing station according to claim 1 to 10 characterized by the driving ability of said compressor being adjustable.
[Claim 12] The piping washing station according to claim 11 characterized by deciding the control-objectives value of the physical condition of a refrigerant according to the driving ability of said compressor.
[Claim 13] The piping washing station according to claim 1 to 12 characterized by deciding the control-objectives value of the physical condition of a refrigerant according to the flow resistance of said washed body.

[Claim 14] The piping washing station according to claim 1 to 13 characterized by deciding the control-objectives value of the physical condition of a refrigerant according to the ambient temperature of said piping washing station.
[Claim 15] The piping washing station connected with the heat souce which is characterized by providing the following, and which has a compressor between washed piping Expansion equipment which makes said piping washing station decompress the refrigerant condensed by said heat exchanger while having the heat exchanger which makes the refrigerant of said heat souce or said piping washing station breathed out by either from said compressor at least condense The washed object recovery means which carries out separation recovery of the washed object from the refrigerant which circulated said washed piping The washing side control unit whose transmission of operation information is enabled from the heat-source side control unit which said heat souce has
[Claim 16] A washing side control unit is a piping washing station according to claim 15 characterized by controlling any one at least according to the operational status of heat souce among the amount of heat exchange of a heat exchanger, the amount of drawing of expansion equipment, or the operation capacity of a compressor.
[Claim 17] The piping washing station connected with the heat souce which has the heat-source side control unit which is characterized by providing the following, and whose transmission of operation information is enabled at a compressor and the control device arranged outside between washed piping Expansion equipment which makes said piping washing station decompress the refrigerant condensed by said heat exchanger while having the heat exchanger which makes the refrigerant of said heat souce or said piping washing station breathed out by either from said compressor at least condense The washed object recovery means which carries out separation recovery of the washed object from the refrigerant which circulated said washed piping The washing side control unit whose transmission of operation information is enabled between said heat-source side control unit or/and said control device
[Claim 18] A control device is a piping washing station according to claim 17 characterized by controlling any one at least according to the operational status of heat souce and a piping washing station among the amount of heat exchange of a heat exchanger, the amount of drawing of expansion equipment, or the operation capacity of a compressor.
[Claim 19] The piping washing station according to claim 15 to 18 characterized by to equip a heat-source side control unit with the function suspend operation of the compressor arranged in said heat souce when fault occurs in transmission of the operation information between the control device arranged between the heat-source side control unit which heat souce had, and the washing side control units which the piping washing station had, or in the exterior, said heat-source side control unit, and said washing side control unit.
[Claim 20] The piping washing station according to claim 15 to 18 characterized by having the storage means or a display means to display of a heat-source side control unit, a washing side control unit, or a control device to record the advance situation of piping washing operation on any one at least.
[Claim 21] The piping washing station according to claim 15 to 18 characterized by recording completion or un-completing on the storage means of a heat-source side control unit, a washing side control unit, or a control device which it had in any one at least. [of piping washing operation]
[Claim 22] The piping washing station according to claim 20 characterized for the function which resumes piping washing operation based on record of the advance situation of piping washing operation by the thing of a washing side control unit or a control device with which either was equipped at least when piping washing operation is interrupted by un-completing.
[Claim 23] The piping washing station according to claim 21 characterized by forbidding operations other than piping washing operation in heat souce when completion record of piping washing operation is not made by the heat-source side control unit.
[Claim 24] The piping washing approach of carrying out having had the step judge the fitness of said piping washing operation based on the information on the operational status of said piping washing station transmitted to the centralized-control equipment by which remote installation was carried out from the step which removes the frozen air conditioner of established use from established piping, the step which attach a piping washing station in said established piping, the step which perform piping washing operation with said piping washing station, and the control unit which formed to said piping washing station as the description.
[Claim 25] The piping washing approach according to claim 24 characterized by having the step which makes a change of an operation control condition or the amount adjustment of refrigerants by the fitness judging of said piping washing operation.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the washing station which washes the refrigerating machine oil which remains for piping in the case of also exchanging refrigerating machine oil at the same time it exchanges the refrigerant used especially in a frozen air conditioner about the washing station of piping.
[0002]
[Description of the Prior Art] The frozen air conditioner of a separate form generally used from the former is shown in drawing 27 . In drawing 27 , 28 is heat souce and builds in a compressor 1, a four way valve 29, the heat-source side heat exchanger 30, 1st connection valve 12c, 12d of 2nd connection valve, and an accumulator 10. 22 is an interior unit and is equipped with the electronic expansion valve 24 and the use side heat exchanger 23. It is installed in the distant location, the 1st connecting piping 4 and the 2nd connecting piping 6 connect, and heat souce 28 and an interior unit 22 form a refrigerating cycle.
[0003] The end of the 1st connecting piping 4 is connected with a four way valve 29 through 1st connection valve 12c, and other ends of the 1st connecting piping 4 are connected with the use side heat exchanger 23. The end of the 2nd connecting piping 6 is connected with the heat-source side heat exchanger 30 through 12d of 2nd connection valve, and other ends of the 2nd connecting piping 6 are connected with the electronic expansion valve 24. Moreover, oil returning hole 10a is prepared in the lower part of outflow piping of the shape of a U tube of an accumulator 10.
[0004] Drawing 27 explains the flow of the refrigerant of this frozen air conditioner. A continuous-line arrow head shows the flow of a wavy line arrow head's heating operation of the flow of air conditioning operation among drawing. First, the flow of air conditioning operation is explained. Through a four way valve 29, the gas refrigerant of elevated-temperature high pressure compressed with the compressor 1 flows into the heat-source side heat exchanger 30, and heat exchange of it is carried out to heat-source media, such as air and water, here, and it is condensate-ized. The condensate-ized refrigerant flows into the electronic expansion valve 24 through 12d of 2nd connection valve, and the 2nd connecting piping 6, is decompressed to low voltage here, will be in a low voltage vapor-liquid two phase condition, and by the use side heat exchanger 23, heat exchange of it is carried out to use side media, such as air, and it is evaporative-gas-ized. The evaporative-gas-ized refrigerant returns to a compressor 1 through the 1st connecting piping 4, 1st connection valve 12c, a four way valve 29, and an accumulator 10.
[0005] Next, the flow of heating operation is explained. Through a four way valve 29, connection valve 12of ** 1st c, and the 1st connecting piping 4, the gas refrigerant of elevated-temperature high pressure compressed with the compressor 1 flows into the use side heat exchanger 23, and heat exchange of it is carried out to use side media, such as air, here, and it is condensate-ized. The condensate-ized refrigerant flows into the electronic expansion valve 24, is decompressed to low voltage here, will be in a low voltage vapor-liquid two phase condition, and through the 2nd connecting piping 6 and 12d of 2nd connection valve, by the heat-source side heat exchanger 30, heat exchange of it is carried out to heat-source media, such as air and water, and it is evaporative-gas-ized. The evaporative-gas-ized refrigerant returns to a compressor 1 through a four way valve 29 and an accumulator 10.
[0006] Although the CFC (chlorofluorocarbon) system refrigerant and the HCFC (hydrochlorofluorocarbon) system refrigerant have been conventionally used for many of such frozen air conditioners, in order that the chlorine contained in these molecules may destroy an ozone layer in a stratosphere, a CFC system refrigerant is already abolished and production regulation is started also for the HCFC system refrigerant.

[0007] These are replaced and the frozen air conditioner which uses the HFC (hydro fluorocarbon) system refrigerant which does not contain c[redacted]ne in a molecule is put in practical us[redacted]en the frozen air conditioner using a CFC system refrigerant or a HCFC system refrigerant is superannuated, since abolition / production regulation is carried out, it is necessary to change these refrigerants to the frozen air conditioner using a HFC system refrigerant etc.

[0008] When it is the separate mold which consists of connecting piping 4 and 6 to which a frozen air conditioner connects heat souce 28, an interior unit 22, and these, since the refrigerating machine oil, organic material, and heat exchanger used with a HFC system refrigerant differ from them of a HCFC system refrigerant or a CFC system refrigerant, it is necessary to exchange heat souce 28 and an interior unit 22 for the thing only for HFC system refrigerants. Since the heat souce 28 and the interior unit 22 for a CFC system refrigerant or HCFC system refrigerants are superannuated, it is necessary to exchange them, and they are comparatively easy to exchange further from the first.

[0009] On the other hand, when laid under the buildings, such as a case where piping length is long, and a pipe shaft or the underpart of the roof, about connecting piping 4 and 6, it is difficult to exchange for new piping, and piping work can be simplified if the connecting piping 4 and 6 which was being used with the refrigerating cycle equipment using a CFC system refrigerant or a HCFC system refrigerant can be used as it is, since it is moreover hard to be superannuated.

[0010]

[Problem(s) to be Solved by the Invention] However, to the connecting piping 4 and 6 which was being used with the frozen air conditioner using a CFC system refrigerant or a HCFC system refrigerant, the mineral oil which is refrigerating machine oil of the frozen air conditioner which used the CFC system refrigerant and the HCFC system refrigerant remains.

[0011] Drawing 28 is drawing showing the critical solubility which shows the solubility of the refrigerating machine oil for HFC system refrigerants at the time of mineral oil mixing, and a HFC system refrigerant (R407C), an axis of abscissa shows oil quantity (wt%), and an axis of ordinate shows temperature (degree C). Refrigerating machine oil has the condition of not dissolving with the condition of dissolving and dissolving in a refrigerant when intermingled with the refrigerant, but dissociating, and the boundary point of compatibility and separation is dependent on temperature. The range to dissolve is located in the temperature region inserted into minimum temperature and upper limit temperature, and the dissolution property is expressed with the critical solubility of drawing 28 . Mineral oil mixes in the refrigerating machine oil (synthetic oil, such as ester oil and an ether oil) of the frozen air conditioner using a HFC system refrigerant, and the temperature requirement dissolved as the amount of mineral oil increases becomes narrow. And since the refrigerating machine oil for HFC system refrigerants will dissociate and float at the upper layer of liquid cooling intermediation when compatibility with a HFC system refrigerant is lost and liquid cooling intermediation has accumulated in the accumulator 10, as shown in drawing 28 if it mixes more than a constant rate, there is a possibility that refrigerating machine oil may not return from oil returning hole 10a in the lower part of an accumulator 10 to a compressor 1, but the sliding section of a compressor 1 may be burned. Moreover, in the conventional CFC system refrigerant, since synthetic oil was used for the lubricating oil with the HFC system refrigerant to mineral oil having been used for the lubricating oil, when mineral oil remained for established refrigerant piping, in a new refrigerant circuit, the foreign matter (contamination) arose and there was a problem of having blockaded a diaphragm device or damaging a compressor.

[0012] Moreover, corresponding to said problem, carrying out liquid seal of the connecting piping 4 and 6 which was being used with the frozen air conditioner which used the CFC system refrigerant and the HCFC system refrigerant by the penetrant remover (HCFC141b and HCFC225) of dedication which dissolves mineral oil using a washing station, and carrying out dissolution washing of the mineral oil which remains in piping is performed by the former.

[0013] In this case, there was a problem as shown below. The penetrant remover used for the 1st is a HCFC system refrigerant, and since ozone modulus of rupture is not 0, it is contradictory to substituting for the refrigerant of a frozen air conditioner from a HCFC system refrigerant to a HFC system refrigerant. Especially HCFC141b has ozone modulus of rupture as large as 0.11, and it is a problem to wash piping using this refrigerant.

[0014] Moreover, it is raised that inflammability and toxicity are not completely safe for the penetrant remover used for the 2nd. HCFC141b is inflammability and it is low toxicity, and it is low toxicity although HCFC225 is incombustibility.

[0015] Adhered to piping that the penetrant remover after washing cannot evaporate easily, since the boiling point of a penetrant remover is [3rd] still higher (HCFC141b is 32 degrees C and HCFC225 is 51-56 degrees C), in order to collect these, a recovery stroke -- nitrogen gas blows and washes a penetrant remover --

takes time amount.
[0016] Moreover, even if it was going wash using the penetrant remover where there is no problem on the above environments, or are easy to collect, since what has solubility in mineral oil by such penetrant remover hardly existed, it had the problem that washing was not performed promptly.
[0017] It aims at providing the frozen air conditioner simplified in reinstallation construction of piping by this invention being made in order to cancel such a trouble, washing piping when updating equipment in order to exchange the refrigerant used in a frozen air conditioner while obtaining the washing station which can wash piping quickly convenient by the environment, and using washed established piping. Moreover, this invention is simple for exchange of a refrigerant, and aims at acquiring an approach exchanging a reliable frozen air conditioner while it obtains positive completion of the versatility by piping washing operation which used the heat souce for frozen air-conditioning, or washing.
[0018]
[Means for Solving the Problem] The piping washing station concerning claim 1 of this invention connects a compressor, a condenser, expansion equipment, and an evaporator, and it is equipped with the control unit of the flow resistance of the heat exchange capacity of said condenser, and said expansion equipment, and the heat-exchange capacity of said evaporator which controls any one at least so that it may become the recovery system which washes the washed body and collects washed objects with the refrigerant conveyed with said compressor, and the desired value as which the physical condition of said refrigerant was determined beforehand.
[0019] The piping washing station concerning claim 2 of this invention controls the refrigerant with which a control unit flows into said washed body by the control unit to become vapor-liquid two-phases flow.
[0020] The piping washing station concerning claim 3 of this invention equips inlet-side piping of a compressor with a low voltage pressure sensor, and controls a control unit to become beyond the predetermined desired value as which the low voltage pressure detected by said low voltage pressure sensor was determined beforehand.
[0021] The piping washing station concerning claim 4 of this invention equips discharge-side piping of a compressor with a high-pressure pressure sensor, and controls a control unit to become beyond the predetermined desired value as which the high-pressure pressure detected by said high-pressure pressure sensor was determined beforehand.
[0022] The piping washing station concerning claim 5 of this invention equips discharge-side piping of a compressor with a discharge-temperature sensor, and controls a control unit to become below the predetermined desired value as which the discharge temperature detected by said discharge-temperature sensor was determined beforehand.
[0023] The piping washing station concerning claim 6 of this invention equips inlet-side piping of a compressor with a low voltage pressure sensor and an intake-air-temperature sensor, and it controls a control unit so that the inhalation degree of superheat computed by the intake air temperature detected from the low voltage pressure detected from said low voltage pressure sensor and said intake-air-temperature sensor serves as predetermined desired value defined beforehand.
[0024] The piping washing station concerning claim 7 of this invention equips discharge-side piping of a compressor with a condensation outlet temperature sensor at outlet side piping of a high-pressure pressure sensor and a condenser, and controls a control unit to become the predetermined target range where the dryness fraction of the two phase refrigerant computed from the condenser outlet temperature detected from the high-pressure pressure detected from said high-pressure pressure sensor and said condensation outlet temperature sensor was defined beforehand.
[0025] The piping washing station concerning claim 8 of this invention prepares the high low voltage heat exchanger which carries out heat exchange of a part or all of the heat of condensation of a refrigerant that is obtained with a condenser as evaporation heat in an evaporator.
[0026] The piping washing station concerning claim 9 of this invention changes the amount of heat exchange of a high low voltage heat exchanger so that the physical condition of a refrigerant may serve as desired value defined beforehand.
[0027] The piping washing station concerning claim 10 of this invention is equipped with a gas cooling means to cool the refrigerant which flows out of a high low voltage heat exchanger and which evaporated, and changes the refrigeration capacity of said gas cooling means according to the physical condition of a refrigerant.
[0028] The driving ability of a compressor of the piping washing station concerning claim 11 of this invention is adjustable.
[0029] The piping washing station concerning claim 12 of this invention determines the control-objectives value of the physical condition of a refrigerant according to the driving ability of a compressor.

[0030] The piping washing station concerning claim 13 of this invention determines the control-objectives value of the physical condition of a refrigerant according to the flow resistance of the washed body.
[0031] The piping washing station concerning claim 14 of this invention determines the control-objectives value of the physical condition of a refrigerant according to the ambient temperature of a piping washing station.
[0032] The piping washing station concerning claim 15 of this invention While having the heat exchanger which makes either condense at least the refrigerant of said heat souce or said piping washing station breathed out from said compressor in the piping washing station connected with the heat souce which has a compressor between washed piping The expansion equipment which makes said piping washing station decompress the refrigerant condensed by said heat exchanger, It has the washed object recovery means which carries out separation recovery of the washed object from the refrigerant which circulated said washed piping, and the washing side control unit whose transmission of operation information is enabled from the heat-source side control unit which said heat souce has.
[0033] As for the piping washing station concerning claim 16 of this invention, a washing side control unit controls any one at least according to the operational status of heat souce among the amount of heat exchange of a heat exchanger, the amount of drawing of expansion equipment, or the operation capacity of a compressor.
[0034] The piping washing station concerning claim 17 of this invention In the piping washing station connected with the heat souce which has the heat-source side control unit whose transmission of operation information is enabled at the control device arranged in a compressor and the exterior between washed piping While having the heat exchanger which makes the refrigerant of said heat souce or said piping washing station breathed out by either from said compressor at least condense The expansion equipment which makes the refrigerant condensed by said heat exchanger in said piping washing station decompress, It has the washing side control unit which can transmit operation information between the washed object recovery means which carries out separation recovery of the washed object from the refrigerant which circulated said washed piping, and said heat-source side control unit or/and said control device.
[0035] As for the piping washing station concerning claim 18 of this invention, a control device controls any one at least according to the operational status of heat souce and a piping washing station among the amount of heat exchange of a heat exchanger, the amount of drawing of expansion equipment, or the operation capacity of a compressor.
[0036] The piping washing station concerning claim 19 of this invention equips a heat-source side control unit with the function to suspend operation of the compressor arranged in said heat souce, when fault occurs in transmission of the operation information between the control device arranged between the heat-source side control unit which heat souce had, and the washing side control units which the piping washing station had, or in the exterior, said heat-source side control unit, and said washing side control unit.
[0037] The piping washing station concerning claim 20 of this invention is equipped with the storage means or a display means to display of a heat-source side control unit, a washing side control unit, or a control device to record the advance situation of piping washing operation on any one at least.
[0038] The piping washing station concerning claim 21 of this invention records completion or un-completing on the storage means of a heat-source side control unit, a washing side control unit, or a control device which it had in any one at least. [of piping washing operation]
[0039] When piping washing operation is interrupted by un-completing, the piping washing station concerning claim 22 of this invention equips either with the function which resumes piping washing operation based on record of the advance situation of piping washing operation, even if there are few washing side control units or control devices.
[0040] The piping washing station concerning claim 23 of this invention forbids operations other than piping washing operation in heat souce, when completion record of piping washing operation is not made by the heat-source side control unit.
[0041] The piping washing approach concerning claim 24 of this invention has the step judge the fitness of said piping washing operation based on the information on the operational status of said piping washing station transmitted to the centralized-control equipment by which remote installation was carried out from the step which removes the frozen air conditioner of established use from established piping, the step which attach a piping washing station in said established piping, the step which perform in piping washing operation by said piping washing station, and the control unit prepared to said piping washing station.
[0042] The piping washing approach concerning claim 25 of this invention is equipped with the step which makes a change of an operation control condition or the amount adjustment of refrigerants by the fitness judging of piping washing operation.

[0043]
[Embodiment of the Invention] The gestalt 1 of operation of below gestalt 1. the invention of operation is explained based on drawing. Drawing 1 is the refrigerant circuit Fig. of the piping washing station by the gestalt 1 of operation. In drawing, 1 is a condenser and established piping to which an oil separator and 3 connect four to and, as for a compressor and 2, six connect the heat souce and the interior unit of a frozen air conditioner, and, for washed piping, the by-path pipe to which 5 connects the end of the established piping 4 and 6, and 7, as for an evaporator and 9, an electronic expansion valve and 8 are [the separation recovery system of a washed object and 10] accumulators. 11 was a piping washing station, the piping washing station 11 made sequential connection of a compressor 1, an oil separator 2, a condenser 3, the electronic expansion valve 7, an evaporator 8, the separation recovery system 9, and the accumulator 10, and was constituted, and the by-path pipe 5 of the established piping 4 and 6 was not connected -- it already connects with an end through the connection valves 12a and 12b. The compressor 1 is a rotational frequency adjustable compressor, the refrigerant flow rate conveyed by changing a rotational frequency can be fluctuated, and a condenser 3 and an evaporator 8 perform the open air and heat exchange of piping washing station 11 perimeter which are ventilated by the fan (not shown). Moreover, the temperature sensor with which 13a measures the discharge temperature of a compressor 1, the temperature sensor with which 13b measures the temperature of the outlet of a condenser 3 and the inlet port of the washed piping 4, the temperature sensor with which 13c measures the intake air temperature of a compressor 1, the pressure sensor with which 14a measures the high-pressure pressure of a piping washing station, and 14b are pressure sensors which measure the low voltage pressure of a piping washing station. 15 is a measurement control unit which controls the fan airflow of the rotational frequency of a compressor 1, a condenser 3, and an evaporator 8, and the opening of the electronic expansion valve 7 from the measurement value of temperature sensors 13a, 13b, and 13c and pressure sensors 14a and 14b.
[0044] As shown in drawing 1 , the refrigerating cycle consists of this invention, and R407C which is a HFC system mixing refrigerant as a refrigerant which circulates through a refrigerating cycle is used. R407C is the non-azeotropy mixing refrigerant which R32/R125/R134a mixed at a rate (23/25/52wt%), and the ester oil which has this refrigerant and compatibility is used as refrigerating machine oil. Moreover, the frozen air conditioner with which the established piping 4 and 6 used the HCFC system refrigerant was connected in the past, and the mineral oil which is refrigerating machine oil for HCFC system refrigerants remains for this established piping. The solubility of the mineral oil to R407C is 1% or less, and does not almost have solubility with mineral oil.
[0045] Next, the washing procedure of this invention is explained. The required heat souce of the exchange connected to the established piping 4 and 6 and an interior unit are removed, and the piping washing station 11 and a by-path pipe 5 are connected to the established piping 4 and 6 like drawing 1 . After carrying out vacuum suction of the whole refrigerating cycle after connection, optimum dose restoration of R407C is carried out. A compressor 1 is operated after that. The operation situation of the refrigerating cycle at this time is as follows. The gas refrigerant of elevated-temperature high pressure breathed out from the compressor 1 passes an oil separator 2 first. It is separated by the oil separator 2 and the refrigerating machine oil breathed out from the compressor 1 together with the gas refrigerant in this phase is returned to the inlet side of a compressor 1. After that, with a condenser 3, a part of gas is cooled, and the gas refrigerant of elevated-temperature high pressure serves as liquid, and turns into a high-pressure vapor-liquid two phase refrigerant. After this high-pressure vapor-liquid two phase refrigerant passes the established piping 4, a by-path pipe 5, and the established piping 6 and washes these interior of piping, it is decompressed by the low-pressure vapor-liquid two phase refrigerant by the electronic expansion valve 7. It is heated with an evaporator 8 after this, and becomes low-pressure gas. Next, the separation recovery system 9 is passed, in this case, the mineral oil which was washed within the established piping 4 and 6 and was torn off from the adhesion in piping is separated from a refrigerant, and mineral oil is held at the separation recovery system 9. A low-pressure refrigerant gas is inhaled by the compressor 1 through an accumulator 10 after this.
[0046] Thus, it becomes possible to pour the refrigerant with which liquid was mixed with vapor-liquid two phase interflow, i.e., gas, by making the refrigerating cycle by the piping washing station operate by established piping which is washed piping. Here, the reason for washing by pouring a vapor-liquid two phase refrigerant for established piping is explained. Drawing 2 is drawing having shown the washing property by the amount of piping survival and washing time amount of mineral oil for every condition of the refrigerant at the time of washing about this invention, and the amount of mineral oil to which an axis of abscissa remains to washing time amount, and an axis of ordinate remains for piping after washing is expressed. As shown in drawing 2 , when washing mineral oil, in three conditions, gas single phase, liquid single phase, and a vapor-liquid two phase (gas liquor mixing), it turns out that the washing property when washing by the vapor-liquid two phase

expressed with the alternate long and short dash line by <> mark in drawing is excellent.
[0047] The conventional washing wa[illegible]shing by dissolving the mineral oil wit[illegible]ich the sink and the penetrant remover adhered to piping by making penetrant removers, such as HCFC225, into liquid single phase at piping. Moreover, since this refrigerant and mineral oil do not almost have solubility when it washes by passing R407C and is washed by passing as liquid for piping as usual, mineral oil will be pulled and moved by shearing force with R407C, and it will wash. In this case, the passing speed of mineral oil is remarkably slow compared with the rate of flow of refrigerant liquid, and takes [washing] time amount and is not practical. It takes [that will pull and move mineral oil by shearing force with R407C similarly also in this case, will wash, and the passing speed of mineral oil washes late] time amount and is not practical although the method of passing R407C as gas is also in piping again.
[0048] On the other hand, when washing by vapor-liquid two phase interflow, since vapor-liquid mixes and flows, two-phases flow becomes larger than the case where the turbulence condition of flow passes liquid single phase and gas single phase. Therefore, turbulence of the liquid cooling intermediation in a vapor-liquid two phase refrigerant becomes large near a piping wall surface, and the operation which tears off the mineral oil adhering to a wall surface from a wall surface is performed. Since the mineral oil torn off from the wall surface moves in the inside of a refrigerant, passing speed becomes the same as a refrigerant. Therefore, it becomes possible to move a refrigerant at high speed compared with making it pull and move by shearing force with R407C, and washing, and washing of mineral oil is performed promptly for a short time.
[0049] Thus, in piping washing, although it depends for the washing property of the mineral oil removal by the vapor-liquid two phase refrigerant on the capacity which tears off mineral oil from the capacity to which mineral oil is moved by shearing force, and piping, since such capacity becomes so large that the rate of flow of a refrigerant, i.e., a flow rate, becomes large, washing capacity improves, so that a refrigerant flow rate is large. Therefore, if a refrigerant flow rate increases, washing will become possible for a short time, or more sufficient washing is attained even if it is the same washing time amount.
[0050] After washing termination of piping suspends operation of a compressor 1, and closes connection valve 12a. The refrigerant breathed out from the compressor 1 is driven in and accumulated in a condenser 3, if a compressor 1 is operated again after that, since connection valve 12a is closed, on the other hand, the accumulator 10 HE drawer of the refrigerant in the established piping 4 and 6 or a by-path pipe 5 is carried out, it is performing the so-called pump-down operation, and it collects R407C which remains in the established piping 4 and 6. Since the boiling point of R407C is easily evaporative-gas-ized by performing this pump-down operation with -43 degrees C since it is low, it can also perform recovery of R407C as a penetrant remover easily. After pump-down operation termination closes connection valve 12b, and ends recovery of R407C.
[0051] After R407C recovery removes the piping washing station 11 and a by-path pipe 5 from established piping, attaches the heat souce and the interior unit which are newly installed after exchange, and completes washing of established piping, and exchange of a frozen air conditioner. Thus, by carrying out, exchange of a frozen air conditioner is attained simply, without reinstalling piping.
[0052] Next, the operating method of the piping washing station 11 under washing operation is explained. Washing capacity is raised, and in order to realize short-time-izing of washing time amount, and more sufficient washing, it is necessary to carry out operation to which the washing flow rate by the refrigerant becomes large, as mentioned above. Then, the refrigerant flow rate conveyed, so that the suction pressure of a compressor 1, i.e., low voltage, is so high that the rotational frequency of a compressor 1 is large as shown in drawing 3 when its attention is paid to the operational characteristics of a compressor 1 increases. Then, in washing operation, the rotational frequency of a compressor 1 is operated at the highest possible rotational frequency in the range which does not have trouble in operation. Thus, by operating, the refrigerant flow rate conveyed increases and can improve washing capacity. However, when there is a possibility that the high pressure of a compressor discharge side may exceed the permission design pressure of the piping washing stations 11, such as a compressor 1, or when there is a possibility that overload operation may be performed and the operating duty of a compressor 1 may exceed an allowed value, a rotational frequency is reduced suitably, and is operated and the dependability of compressor 1 operation is secured.
[0053] Even if it is a case so that operation capacity may be changed by changing, the approaches (number of cylinders), for example, number of gas columns, other than the approach of carrying out adjustable [of the rotational frequency of a compressor], in addition, similarly The operation capacity of a compressor is greatly controlled so that the refrigerant flow rate of many [under / washing operation] as possible flows. When there is a possibility that high pressure may exceed the permission design pressure of the piping washing stations 11, such as a compressor 1, or when there is a possibility that it may become overload operation and the operating duty of a compressor 1 may exceed an allowed value, operation capacity is reduced suitably, and is

operated and the dependability of compressor 1 operation is secured.
[0054] Moreover, in order to enlarge washing flow rate, controlling the low-tension side pressure of the refrigerating cycle which is the suction pressure of a compressor to become high can also respond. For example, the washing flow rate which can carry out the completion of washing is beforehand defined in target washing time amount, and when the rotational frequency of a compressor 1 is determined, the desired value of the low voltage pressure for securing a flow rate required for washing from correlation of drawing 3 can be determined. Each device of the piping washing station 11 is controlled to be able to realize this low voltage. For example, when the current low voltage pressure under washing operation is lower than desired value, opening of the electronic expansion valve 7 is enlarged, or low voltage is raised by making the fan airflow of an evaporator 8 increase. Moreover, low voltage can be raised even if it decreases the fan airflow of a condenser 3. In this case, high pressure rises by reduction of fan airflow, and low voltage rises with that rise.
[0055] In addition, although the desired value of a low voltage pressure is defined, a low-pressure value may come during operation beyond this value. In this case, since the refrigerant flow rate conveyed with a compressor 1 increases more, washing capacity improves further, and more sufficient washing is attained even if it is the same washing time amount. However, if low voltage is operated too much highly, also when there is a possibility that the refrigerant flow rate conveyed with a compressor 1 may become large too much, a compressor 1 may serve as overload operation, and an operating duty may exceed an allowed value, it will generate. In such a case, the upper limit of a low voltage pressure is defined and the opening of reduction and the electronic expansion valve 7 is small controlled [the fan airflow of a condenser 3] for an increment and the fan airflow of an evaporator 8 not to carry out operation which becomes more than this low voltage pressure.
[0056] Moreover, as an operating method of the piping washing station 11 under washing operation, the desired value of a high-pressure pressure is defined beforehand, and the piping washing station 11 may be operated so that it may become this desired value. If high pressure is high, the temperature of the two phase refrigerant to wash will also rise and the temperature of treated oil-ed will also rise in connection with it. Since the viscosity of liquids, such as an oil, falls so that it becomes an elevated temperature, in case mineral oil is moved by shearing force, it becomes easy to move mineral oil and its washing capacity improves. Then, the temperature from which required washing capacity is acquired is defined beforehand, and let the pressure which can realize the temperature be the desired value of a high-pressure pressure. When washing capacity is considered about this temperature, it is desirable to be set as 30 degrees C or more. The piping washing station 11 is operated so that it may become the desired value of this high-pressure pressure. For example, when the current high pressure under washing operation is lower than desired value, high pressure is raised by decreasing the fan airflow of a condenser 3. Moreover, opening of the electronic expansion valve 7 may be enlarged, or the fan airflow of an evaporator 8 may be made to increase. By carrying out like this, low voltage can rise and high pressure can be raised with the rise.
[0057] In addition, although the desired value of a high-pressure pressure is defined, a high-pressure pressure value may come during operation beyond this value. In this case, since the viscosity of an oil falls further, improvement in the further washing capacity is realizable. However, if high pressure is operated too much highly, also when there is a possibility of exceeding the permission design pressure of the piping washing stations 11, such as a compressor 1, it will generate. In such a case, the upper limit of a high-pressure pressure is defined and the fan airflow of a condenser 3 and an evaporator 8 and the opening of the electronic expansion valve 7 are controlled not to carry out operation which becomes more than this high pressure.
[0058] Moreover, since the pressure loss of piping becomes large when the piping length of the washed piping 4 and 6 is long, if high pressure is not made to some extent high, low voltage will fall by the pressure loss of piping, and the case where it falls from the flow rate which needs for washing the refrigerant flow rate conveyed with a compressor 1 will occur. Also in order to correspond to such a situation, high pressure is operated so that it may become high beyond a certain value, so that low voltage may not fall beyond the need. The control approach which makes high pressure in this case high can be enforced by the same approach as the approach mentioned above.
[0059] Moreover, the upper limit of the discharge temperature of a compressor 1 may be beforehand defined as an operating method of the piping washing station 11 under washing operation. As mentioned above, when operation which raises high pressure is performed, in connection with it, a discharge temperature also becomes easy to rise. If a discharge temperature rises to the temperature which causes degradation of the oil in a compressor 1 at this time, since the operation dependability of a compressor 1 will be reduced, it is not desirable. In order to avoid such a condition, when there is a possibility that the discharge temperature under operation may exceed the upper limit of a discharge temperature, operation to which a discharge temperature is reduced is performed. Since it becomes effective to reduce high pressure or to reduce the intake air

temperature of a compressor 1 in order to reduce a discharge temperature, or it makes the fan airflow of a condenser 3 increase, and reduces high pressure or reduces the fan airflow of an evaporator 8, it is enlarging opening of the electronic expansion valve 7, and a discharge temperature is reduced by reducing the refrigerant degree of superheat of evaporator 8 outlet, and an intake air temperature.

[0060] Moreover, the range which the refrigerant degree of superheat of the inlet side of a compressor 1 takes may be appointed as an operating method of the piping washing station 11 under washing operation. When control which raises the low voltage of a refrigerating cycle which was mentioned above, and high pressure is performed, depending on control of each device, the refrigerant of compressor 1 inhalation will not be in an overheating gas condition, but liquid returns to a compressor, or the refrigerant degree of superheat of compressor 1 inhalation becomes large too much, an intake air temperature rises, and the case where this causes a discharge-temperature rise occurs. Since the dependability of compressor 1 operation is reduced, in order to secure the dependability in operation of a compressor 1, the rise of the liquid return to a compressor 1 or a discharge temperature is made into the suitable range which the refrigerant degree of superheat of compressor 1 inhalation takes, for example, the range which is the degree of superheat of 5 degrees C - 10 degrees C, and controls a refrigerant degree of superheat within the limits of this. Directly, although control of a refrigerant degree of superheat is controllable by the size of the opening of the electronic expansion valve 7, control of the fan airflow of a condenser 3 and an evaporator 8 may perform it indirectly. Namely, although a degree of superheat is made low by enlarging opening of the electronic expansion valve 7 when a refrigerant degree of superheat is high By reducing the fan airflow of an evaporator 8 as other approaches, the amount of heat exchange in an evaporator 8 is reduced. The fan airflow of a condenser 3 may be reduced, high pressure may be made high, along with it, it is made high, and a degree of superheat may be made low and it may make [low voltage may also make the coolant temperature in the open air and an evaporator 8 approach, may reduce the amount of heat exchange in an evaporator 8 and] a degree of superheat low. Moreover, a degree of superheat is highly controlled by performing actuation opposite to these actuation, when a refrigerant degree of superheat is conversely low.

[0061] Furthermore, the dryness fraction of this vapor-liquid two phase refrigerant may be controlled as an operating method of the piping washing station 11 under washing operation to become within the limits of predetermined by using as a vapor-liquid two phase refrigerant the refrigerant condition which flows into the washed piping 4. When the refrigerant condition which flows into the washed piping 4 is used as a vapor-liquid two phase refrigerant, it is as the above-mentioned explanation that washing capacity improves. Even if it is a vapor-liquid two phase refrigerant, moreover, when the dryness fraction is close to 1 It becomes the spraying style to which the drop is flowing the inside of the flow of gas in the shape of spraying, and becomes almost same flowing as gas single phase. When a dryness fraction is close to 0 It may be hard to acquire the improvement effectiveness of the washing capacity by becoming the cellular style to which air bubbles are flowing, becoming almost same flowing as liquid single phase, and making the inside of the flow of liquid into vapor-liquid two-phases flow. Therefore, even if it is the same vapor-liquid two phase refrigerant, when washing capacity is considered, it is desirable to set to the vapor-liquid two-phases flow which is not the dryness fraction 1 and dryness fraction 0 neighborhood, i.e., the dryness fraction whose dryness fraction is 0.2 to about 0.9. Thus, by using as a vapor-liquid two phase refrigerant the refrigerant condition which flows into the washed piping 4, in order to control the dryness fraction of this two phase refrigerant further to become within the limits of predetermined, the following control is carried out.

[0062] First, although it is the detection approach of the dryness fraction of a vapor-liquid two phase refrigerant, a high-pressure pressure and the outlet temperature of a condenser 3 are measured. When R407C is used as a washing refrigerant, there is correlation as shown in drawing 4 among the correlation of a pressure, temperature, and a dryness fraction by the non-azeotropy nature. Drawing 4 is drawing showing the relation of the dryness fraction of a refrigerant and temperature in pressure regularity, an axis of abscissa shows the dryness fraction of a refrigerant, and an axis of ordinate shows the temperature of a refrigerant. Drawing 4 shows that a dryness fraction also increases the temperature of a refrigerant to increasing proportionally. Therefore, it can ask for a dryness fraction by detecting a pressure and temperature. Although it is the control approach when it is lower than a target dryness fraction, for example, this dryness fraction is lower than 0.2, since the amount of condensation in a condenser 3 is too large in this case, the fan airflow of a condenser 3 is reduced, it is reducing the amount of condensation and a dryness fraction is controlled more highly. Moreover, even if it enlarges opening of the electronic expansion valve 7, the fan airflow of an evaporator 8 may be reduced. By carrying out like this, the degree of superheat in an evaporator 8 decreases, the fields where the gas refrigerant in an evaporator 8 exists decrease in number, and the field where the liquid separation refrigerant exists increases. Then, since the amount of refrigerants which exists in an evaporator 8 increases, the refrigerant of this increment moves to an evaporator 8 from a condenser 3. Therefore, the

amount of refrigerants in a condenser 3 decreases, and the refrigerant dryness fraction in result condenser 3 outlet is controlled in the high direct[redacted] When a dryness fraction is higher tha[redacted]arget dryness fraction, it is performing opposite actuation of these actuation, and a dryness fraction is controlled low.

[0063] Although the change in fan airflow is performing the control approach of the amount of heat exchange of a condenser 3 and an evaporator 8 described above, the fan itself may be stopped as one method of decreasing fan airflow in this case. Moreover, the amount of heat exchange may be changed by fluctuating a closedown or the flowing flow rate for the branched part by the valves 16, such as a solenoid valve, as a configuration which branches the configuration of a condenser 3 or an evaporator 8 to the heat exchanger divided into plurality as shown in drawing 5 instead of making the amount of heat exchange in a condenser 3 and an evaporator 8 fluctuate by the change in fan airflow. in this case, the tee which carries out a closedown by reducing a closedown or a flow rate for a part of branching by controlling the opening of a valve 16 in the closed direction, reducing the amount of heat exchange, and controlling the opening of a valve 16 in the open direction conversely -- reduction -- or or it loses, it is made not to reduce the flow rate of a tee and the amount of heat exchange can also be made to increase

[0064] Moreover, as shown in drawing 6 , the bypass piping 17 which bypasses these heat exchangers may be formed as a configuration of a condenser 3 or an evaporator 8. When make the flow rate which flows for the bypass piping 17 by controlling the opening of a valve 16 in the open direction when the valves 16, such as a solenoid valve which can adjust a closedown or a flow rate, are formed also in this bypass piping 17 and the amount of heat exchange wants to decrease increase and making the amount of heat exchange increase, reduction or bypass piping 17 stop for the flow rate which flows for bypass piping 17 by controlling the opening of a valve 16 in the closed direction. It becomes possible to control the amount of heat exchange of a condenser 3 and an evaporator 8 by performing such control like the case where fan airflow makes it fluctuate.

[0065] Moreover, when the OAT of piping washing station 11 perimeter is low, even if it stops a fan, the amount of heat exchange by the heat dissipation to the open air in a condenser 3 becomes large too much, and also when the control which reduces the amount of heat exchange cannot fully carry out, it generates. In this case, a condenser 3 or the cover which severs the piping washing station 11 whole [open air] may be formed. Drawing showing the configuration of a condenser [in / in drawing 7 / a piping washing station], drawing 8 , drawing 9 , and drawing 10 are drawings showing the installation approach of the cover in a piping washing station. For example, a condenser 3 is installed in the piping washing station 11 like drawing 7 , the open air flows from the open air inlet port 18 of an equipment outline side face, and when it has composition ventilated as shown in drawing to the open air outlet 19 on the top face of an outline, as shown in drawing 8 , the open air and the cover 20 to intercept are formed at open air inlet port 18 and the open air outlet 19. Or as shown in drawing 9 , it covers to the piping washing station 11 whole, and 20 is prepared. It becomes possible to be able to reduce the heat release in the condenser 3 in the case where an OAT is low, and to control appropriately the amount of heat exchange in a condenser 3 by carrying out like this. In addition, when operating a fan, in order to secure the air course of the open air, the air course 21 through which the open air passes to some covers like drawing 10 may be established in these covers 20. Thus, by establishing the air course 21 through which the open air passes, even if it installs a cover 20, operation of control of the amount of heat exchange by the change in fan airflow is attained. In addition, as an installation of a cover 20, it is not all the parts currently illustrated by drawing 8 and drawing 9 , and the same effectiveness can be acquired even if installed in the part.

[0066] Moreover, when the OAT of piping washing station 11 perimeter is low, even if it stops a fan, heating apparatus, such as a heater which heats the refrigerant circuit upstream, the downstream, or the intake open air of a condenser 3, may be installed as other cures in case the amount of heat exchange in a condenser 3 becomes large too much. When heat release becomes large too much, it is heating apparatus and is heating a refrigerant or the intake open air, and it becomes possible to reduce the effect of the heat release which acts on a refrigerant, and it becomes possible to control appropriately the amount of heat exchange in a condenser 3. In addition, although considered as the configuration which carries out heat exchange to the open air as a configuration of a condenser 3 or an evaporator 8, you may be the format which carries out heat exchange by other media, such as a hydrothermal intersection. In this case, the same control as the case where fan airflow is controlled by controlling the amount of the medium supplied to heat exchangers, such as amount of water, can be performed.

[0067] Moreover, since the pressure loss in piping became large when the washed piping 4 and 6 is long, how to control the opening of the electronic expansion valve 7 greatly was described so that a low voltage pressure might not decline, but even if it sets opening as the maximum opening depending on the configuration of the electronic expansion valve 7, the differential pressure of extent which is the electronic expansion valve 7 is

produced, and also when the fall of a low voltage pressure cannot be prevented it generates. In such a case, a valve 16 is opened, it is making it a refrigerant flow for the bypass piping 17 and the differential pressure in the electronic expansion valve 7 may be reduced to form the valves 16, such as a solenoid valve, in juxtaposition on the bypass piping 17 and the bypass piping 17 at the electronic expansion valve 7, and reduce the differential pressure in the electronic expansion valve 7, as shown in drawing 11 . By carrying out like this, even when [that the washed piping 4 and 6 is long] the pressure loss in piping is large, the fall of a low voltage pressure can be prevented and a refrigerant flow rate required for washing can be secured.

[0068] Although how to make the high-pressure pressure of the piping washing station 11, a low voltage pressure, a discharge temperature, the degree of superheat of compressor inhalation, and the dryness fraction of the refrigerant which flows into the washed piping 4 control by controlling the fan airflow of a compressor 1, a condenser 3, and an evaporator 8 and the opening of the electronic expansion valve 7 was explained by the control approach described so far, these quantity of states may be controlled by adjusting the amount of refrigerants with which the piping washing station 11 is filled up. When a refrigerant fill is made to increase, the high pressure at the time of piping washing station 11 operation is high, low voltage is high, a discharge temperature is low, the degree of superheat of compressor inhalation is low, and the amount of restoration refrigerants is adjusted so that desired value of the high pressure beforehand set up since the dryness fraction of the refrigerant which flows into the washed piping 4 changes low, low voltage, a discharge temperature, the degree of superheat of compressor inhalation, and the dryness fraction of the refrigerant which flows into the washed piping 4 can be realized. It may be filled up with the amount of refrigerants calculated by the formula beforehand decided from information, such as an installation condition of the washed piping 4 and 6, and an OAT, and the amount of refrigerants with which it fills up may be made to fluctuate about this fill from the deflection of the operational status in the middle of washing operation, and each desired value.

[0069] Moreover, when the flow resistance in the washed piping 4 and 6 is large (for example, when [the case where the washed piping 4 and 6 is long, when a line size is small] etc.), the control-objectives value in washing operation of the piping washing station 11 may be changed according to the flow resistance of the washed piping. For example, when the flow resistance in the washed piping 4 and 6 is large, a low voltage pressure does not rise and a flow rate required for washing cannot be secured, low voltage is raised and a refrigerant flow rate required for washing is made to secure by correcting the desired value of a high-pressure pressure highly. Or it corrects low the desired value of the dryness fraction of the refrigerant which flows into the washed piping 4 and 6 in order to reduce flow resistance since it increases so that the rate of flow resistance in the washed piping 4 and 6 of gas increases, namely, it becomes a high dryness fraction when vapor-liquid two-phases flow flows. Flow resistance in the washed piping 4 and 6 is made small by this thing [carrying out], low voltage is raised, and a flow rate required for washing is made to secure. In addition, about the flow resistance in the washed piping 4 and 6, the information about the gestalt of the washed piping 4 and 6 is beforehand inputted to the measurement control unit 15 in front of washing operation, flow resistance is judged from the input value, the desired value of operation may be changed, when low voltage lengthens and does not go up from operational status while carrying out washing operation, it may judge that flow resistance is large, and you may change the desired value of operation.

[0070] Although operation of the above piping washing station 11 explained the case where it washed by removing the interior unit attached in the end of the washed piping 4 and 6, even if it washes attaching an interior unit 22 as shown in drawing 12 , operation which raised washing capacity can be carried out by performing the same operation control. Drawing 12 is the refrigerant circuit Fig. showing other gestalten of a piping washing station, in drawing, an interior unit and 23 attach a use side heat exchanger, as for 22, 24 attaches a same sign to an electronic expansion valve and the same part as drawing 1 , and the explanation is omitted. About this interior unit 22, though it washes to the washed piping 4 and 6 and coincidence, after exchange of heat souce is continued and the interior unit 22 connected from before piping washing is used, it is good, and washing operation may be performed, exchanging for the new interior unit 22 and connecting this establishment interior unit 22 at exchange and coincidence of heat souce.

[0071] As shown above, in the operation control of the piping washing station 11, a refrigerant flow rate required for washing is secured. By making high temperature of the refrigerant which flows into the washed piping 4, and making the refrigerant condition which flows into the washed piping 4 into the vapor-liquid two-phases flow of the dryness fraction within a certain defined limits While realizing operation which raised washing capacity, it becomes possible by controlling high pressure, the discharge temperature of a compressor 1, and the inhalation dryness fraction of a compressor 1 not to make operation of the piping washing station 11 produce a problem to raise the dependability of operation of the piping washing station 11.

[0072] as a washing refrigerant which washes piping, it does not restrict to R407C, and other single refrigerants and mixed refrigerants of a HFC system are sufficient, for example, you may wash by R32 (fine

inflammability - nonpoisonous), R125 (noncombustible - nonpoisonous), R134a (noncombustible - nonpoisonous), R410A (noncombustible - nonpoisonous), and R404A (noncombustible - nonpoisonous). Moreover, natural refrigerants, such as HC system refrigerants, such as a propane, butane, and an isobutane, and the mixed refrigerant and ammonia, and carbon dioxide gas, may be used.

[0073] The gestalt 2 of operation of below gestalt 2. this invention of operation is explained based on drawing. Drawing 13 is the refrigerant circuit Fig. of the piping washing station in the gestalt 2 of operation. In drawing, 25 is a high low voltage heat exchanger, gives this agreement to the same part as drawing 1 of the gestalt 1 of other operations, and omits explanation. Heat exchange is performed between the high-pressure refrigerant cooled in part with the condenser 3 in the high low voltage heat exchanger 25, and the low-pressure refrigerant which flowed out of the electronic expansion valve 7. Drawing 14 is the circuitry Fig. of this high low voltage heat exchanger 25, and in drawing, 26 is a double pipe and has the composition of a high-pressure refrigerant flowing in outside tubing, and flowing to the sense to which the low voltage refrigerant countered inside tubing. The amount of heat exchange in the high low voltage heat exchanger 25 can be controlled now by 17 adjusting the refrigerant flow rate which bypass piping in a low-tension side refrigerant style and 16 are valves, such as a solenoid valve which adjusts the refrigerant flow rate which flows the bypass piping 17, and passes the bypass piping 17 by closing motion of a valve 16.

[0074] The operation situation of this piping washing station is explained based on PH diagram of drawing 15 . In drawing, Enthalpy H is shown on an axis of abscissa, and a pressure is shown on an axis of ordinate. The gas refrigerant (A) of elevated-temperature high pressure breathed out from the compressor 1 shown by drawing 13 passes an oil separator 2 first. It is separated by the oil separator 2 and the refrigerating machine oil breathed out from the compressor 1 together with the gas refrigerant in this phase is returned to compressor 1 inlet side. The gas refrigerant of elevated-temperature high pressure serves as gas to which the compressor was cooled by the input and temperature fell with the condenser 3 after that (B). After that, after being further cooled in part by the high low voltage heat exchanger 25 and this high-pressure gas refrigerant passes (C), the established piping 4, a by-path pipe 5, and the established piping 6, it is decompressed by the low-pressure vapor-liquid two phase refrigerant by the electronic expansion valve 7 (D). It is heated by the quantity low voltage heat exchanger 25 after this, and becomes low-pressure gas (E). Since the amount of heat exchange of the high-tension side and the amount of heat exchange of the low-tension side become the same at this time, the enthalpy difference between BC and the enthalpy difference between DE become the same value. Next, the separation recovery system 9 is passed, the mineral oil washed within the established piping 4 and 6 is separated in this case, and mineral oil is held at the separation recovery system 9. A low-pressure refrigerant gas is inhaled by the compressor 1 through an accumulator 10 after this. Thus, although the efficiency of heat transfer by the side of air was bad and the heat exchanger size of an evaporator 8 became large since the heat exchange with the open air was required of the evaporator 8 as the gestalt 1 of the above-mentioned operation showed when it replaced with an evaporator 8 and the high low voltage heat exchanger 25 was formed Since heat exchange is performed between refrigerants in the case of the high low voltage heat exchanger 25, efficiency of heat transfer is good, and the size of the high low voltage heat exchanger 25 becomes small, and becomes possible [creating the piping washing station 11 in a compact].

[0075] Next, the operation control of the piping washing station 11 is explained. Since it becomes the same as the gestalt 1 of operation about the approach of making the dryness fraction of the refrigerant which flows into the high-pressure pressure of the piping washing station 11, a low voltage pressure, a discharge temperature, the degree of superheat of a compressor inlet side, and the washed piping 4 by control of the fan airflow of a compressor 1 and a condenser 3, and the opening of the electronic expansion valve 7, and adjustment of a refrigerant fill controlling, explanation is omitted. Next, although it is the control approach of the amount of heat exchange of the high low voltage heat exchanger 25, if the amount of heat exchange of the high low voltage heat exchanger 25 is enlarged, both the heat exchange capacity to make a high-pressure refrigerant condense, and the heat exchange capacity to evaporate a low voltage refrigerant will increase. Enthalpy H is shown on an axis of abscissa, a pressure P is shown on an axis of ordinate, drawing 16 is PH Fig. showing the operation situation at the time of the amount change of heat exchange of the high low voltage heat exchanger of a piping washing station, and a dotted line is [a continuous line is the amount size of heat exchange and] heat exchange **** here. Therefore, as the continuous line of drawing 16 shows, the refrigerant dryness fraction by which the high-tension side flows into the refrigerant dryness fraction 4 of the high-tension-side outlet of the high low voltage heat exchanger 25 which a fall and the low-tension side go up and turns into a condenser, i.e., washed piping, as operational status of the piping washing station 11 becomes low, and the refrigerant degree of superheat of a low-tension side outlet becomes high. In connection with the refrigerant degree of superheat of the low-tension side outlet of the high low voltage heat exchanger 25 becoming high, the inhalation degree of superheat of a compressor 1 also becomes high, and, thereby, the discharge

temperature of a compressor 1 becomes high.

[0076] In making desired value control the discharge temperature of a compressor, the degree of superheat of compressor 1 inhalation, and the dryness fraction of the refrigerant which flows into the washed piping 4, according to the control characteristic of this high low voltage heat exchanger 25, it controls the amount of heat exchange. On the other hand, although it is the case where high pressure and low-pressure control are carried out, low voltage is low, and since the refrigerant flow rate required for washing is not securable, the amount of heat exchange of the high low voltage heat exchanger 25 is controlled small to pull up low voltage and increase a refrigerant flow rate. Thus, if it controls, high pressure will be high and low voltage will be controlled low. Since the differential pressure between the washed piping 4 - the electronic expansion valve 7 becomes large at this time, when the flow resistance of the washed piping 4 - the electronic expansion valve 7 does not change, it becomes possible to pass more refrigerant flow rates. Then, the refrigerant flow rate which low voltage rises and is conveyed with a compressor 1 so that it may become a refrigerant flow rate corresponding to the increment in differential pressure is increased. Therefore, if the amount of heat exchange of the high low voltage heat exchanger 25 is controlled small, along with high pressure becoming high as a result, low voltage will also become high and operation of it to which a refrigerant flow rate is made to increase will be attained. Moreover, when [which it will be / when / in an overload operation condition, you make / when / it low also with high low voltage, and a refrigerant flow rate wants to decrease] it seems that he wants to operate, the amount of heat exchange of the high low voltage heat exchanger 25 is controlled greatly conversely.

[0077] In addition, the optimal range exists in the amount of heat exchange of the high low voltage heat exchanger 25. In order to make a refrigerant flow rate increase, it increases so that the amount of heat exchange is small, as mentioned above, but if it is made too much small, the refrigerant degree of superheat in compressor 1 inhalation is set to 0, the liquid back to a compressor 1 occurs, and it is not desirable on the dependability of a compressor 1. Moreover, when it becomes operation to which liquid cooling intermediation returns to a compressor 1 in this way, it becomes operation in which liquid cooling intermediation accumulates in the accumulator 10 in the inlet side of a compressor 1. In order that the amount of refrigerants which exists in other refrigerating cycles, such as the washed piping 4 and 6, may decrease at this time, in the washed piping 4 and 6, the capacity in vapor-liquid two-phases flow increases, namely, a dryness fraction increases, and the flow resistance in the piping 4 and 6 washed [result] increases. If the piping length of the washed piping 4 and 6 is long, and operation which carries out flow resistance increase further is carried out when flow resistance is large from the first, a low voltage pressure will decline and it will become operation which, as a result, cannot secure a refrigerant flow rate required for washing. Moreover, if the amount of heat exchange of the high low voltage heat exchanger 25 is enlarged, since a refrigerant flow rate decreases and washing capacity declines, it is not desirable, but if the discharge temperature of a compressor 1 will become high if the amount of heat exchange is enlarged and an inhalation degree of superheat is made to increase to coincidence, and it becomes temperature high to remainder, it is not desirable on the dependability of a compressor.

[0078] As mentioned above, it is desirable to set the inhalation degree of superheat of the compressor 1 produced as a result to the suitable predetermined range, for example, the range in which the degree of superheat of compressor 1 inhalation becomes 20 degrees C or less more greatly than 0 degree C, as design capacity of the amount of heat exchange of the high low voltage heat exchanger 25, and also when controlling the amount of heat exchange of the high low voltage heat exchanger 25, it is desirable for the inhalation degree of superheat of a compressor 1 to be similarly controlled by the suitable predetermined range.

[0079] In addition, you may make it change according to an OAT about the amount of heat exchange of the high low voltage heat exchanger 25. In operation of the piping washing station 11, when an OAT is low, an operation situation comes to be shown in drawing 17 . Drawing 17 is drawing having shown the operation situation of the piping washing station in the OAT of 40 degrees C, 20 degrees C, and -5 degrees C, Enthalpy H is shown on an axis of abscissa, and a pressure is shown on an axis of ordinate by it. Since the washed piping 4 and 6 and the heat dissipation from the piping washing station 11 become large in the case of -5-degree C OAT (continuous line in drawing), the outlet enthalpy (D) of the washed piping 6 and the enthalpy (E) of compressor 1 inhalation tend to become small. Consequently, the degree of superheat of compressor 1 inhalation serves as operation which becomes small. When an OAT is still lower, or when the piping length of the washed piping 4 and 6 is long and heat release tends to become large, the degree of superheat of compressor 1 inhalation becomes still smaller, and the liquid back to a compressor 1 occurs, or it becomes operation to which a refrigerant accumulates in an accumulator 10 and a lump refrigerant flow rate falls. Then, in order to avoid such a situation, when an OAT is low, it controls so that the amount of heat exchange of the high low voltage heat exchanger 25 becomes large beforehand. Thus, if it controls, while being able to realize operation which secured the degree of superheat of compressor inhalation appropriately and being able to

secure the dependability of a compressor 1, it becomes possible to secure a refrigerant flow rate required for washing.

[0080] On the other hand, since the amount of endoergic from the open air becomes greatly in the washed piping 4 and 6 and the piping washing station 11 in an operation situation when an OAT is high in operation of the piping washing station 11 as is shown in the case of 40-degree C OAT of drawing 17 (alternate long and short dash line in drawing), the outlet enthalpy (D) of the washed piping 6 and the enthalpy (E) of compressor 1 inhalation tend to become large. Consequently, the degree of superheat of compressor 1 inhalation serves as operation which becomes large. In this case, if a discharge temperature rises and it becomes temperature with a high OAT and a discharge temperature high to remainder, it is not desirable on the dependability of a compressor 1. Then, in order to avoid such a situation, when an OAT is high, it controls so that the amount of heat exchange of the high low voltage heat exchanger 25 becomes small beforehand. Thus, if it controls, operation to which the degree of superheat of compressor inhalation becomes low can be realized, and the dependability of a compressor can be secured.

[0081] As mentioned above, by controlling appropriately the amount of heat exchange of the high low voltage heat exchanger 25, while securing the dependability of compressor 1 operation, operation which secured the refrigerant flow rate required for washing is realizable.

[0082] In addition, in the gestalt 1 of this operation, although the high low voltage heat exchanger 25 was explained having consisted of double pipes, the same effectiveness can be acquired by carrying out very same control for other heat exchanger gestalten, such as a plate heat exchanger. Moreover, as the control approach of the amount of heat exchange as shown in other circuitry Figs. of the high low voltage heat exchanger shown in drawing 18 , two or more heat exchangers may be prepared and the amount of heat exchange may be controlled by stopping reduction or passage for the refrigerant flow rate which flows to the part by the valve 16.

[0083] The gestalt 3 of operation of below gestalt 3. this invention of operation is explained based on drawing. Drawing 19 is the refrigerant circuit Fig. of the piping washing station by the gestalt 3 of operation. In drawing 19 , 27 is a syngas cooler, gives a same sign to the same part as the gestalt 1 of other operations, and the gestalt 2 of operation, and omits the explanation. A syngas cooler 27 performs the surrounding open air and the heat exchange of the piping washing station 11 which are ventilated by the fan.

[0084] The operation situation of this piping washing station 11 is explained based on PH diagram of drawing 20 . In drawing, an axis of abscissa shows Enthalpy H and an axis of ordinate shows a pressure. The gas refrigerant (A) of elevated-temperature high pressure breathed out from the compressor 1 shown in drawing 19 passes an oil separator 2 first. It is separated by the oil separator 2 and the refrigerating machine oil breathed out from the compressor 1 together with the gas refrigerant in this phase is returned to the inlet side of a compressor 1. After being cooled by the quantity low voltage heat exchanger 25 after that, and the breathed-out gas refrigerant of elevated-temperature high pressure turning into a vapor-liquid two phase refrigerant and passing (B), the established piping 4, a by-path pipe 5, and the established piping 6, a low-pressure vapor-liquid two phase refrigerant decompresses with a decompression device 7 (C). It is heated by the quantity low voltage heat exchanger 25 after this, and becomes low-pressure gas (D). Since it serves as an elevated temperature from the open air by almost all service conditions at this time since the refrigerant of the high-tension side which flows into the high low voltage heat exchanger 25 is the discharge condition of a compressor 1, and heat exchange is carried out to the refrigerant of another side of the high low voltage heat exchanger 25, the temperature of low-pressure gas also turns into temperature higher than the open air. Since the amount of heat exchange of the high-tension side and the amount of heat exchange of the low-tension side become the same at this time, the enthalpy difference between AB(s) and the enthalpy difference between CDs become the same value. And this blasting-fumes refrigerant is cooled by the open air with a syngas cooler 27 (E). Next, the separation recovery system 9 is passed, the mineral oil washed within the established piping 4 and 6 is separated in this case, and mineral oil is held at the separation recovery system 9. A low-pressure refrigerant gas is inhaled by the compressor 1 through an accumulator 10 after this. Thus, when it replaces with a condenser 3 and the high low voltage heat exchanger 25 is formed, since the heat exchange with the open air was required of the condenser 3, the efficiency of heat transfer by the side of air is bad, although the heat exchanger size of a condenser 3 became large, since heat exchange is performed between refrigerants in the case of the high low voltage heat exchanger 25, efficiency of heat transfer is good, and the size of the high low voltage heat exchanger 25 becomes small, and becomes possible [creating a piping washing station in a compact].

[0085] Next, the operation control of the piping washing station 11 is explained. Since it becomes the same as the gestalt 1 of operation, and the gestalt 2 of operation about the approach of making the dryness fraction of the refrigerant which flows into the high-pressure pressure of the piping washing station 11, a low voltage

pressure, a discharge temperature, the degree of superheat of compressor inhalation, and the washed piping 4 by control of the amount of heat exchange of a compressor 1 and the high low voltage heat exchanger 25, and the opening of the electronic expansion valve 7, and adjustment of a refrigerant fill controlling, explanation is omitted.

[0086] Next, although it is the control approach of a syngas cooler 27, if a syngas cooler 27 is controlled, it will become the following operation situations. If the fan airflow of a syngas cooler 27 is increased, since the amount of cooling will increase, the inhalation degree of superheat of a compressor becomes small, and a discharge temperature becomes low in connection with it. A fall of a discharge temperature also reduces the inlet gas temperature of the high low voltage heat exchanger 25. If the refrigerant condition of the high-tension side in the high low voltage heat exchanger 25 is seen here, it is cooled from a gas refrigerant, and it will become a saturation gas refrigerant, will exist as gas in the meantime, and will be cooled further after that, a part of gas will be condensed, and it will become a vapor-liquid two phase refrigerant. The efficiency of heat transfer of the high low voltage heat exchanger 25 becomes good, and the amount of heat exchange also increases, so that the part in which a two phase refrigerant exists increases, since the vapor-liquid two phase refrigerant which condensation produces becomes good in 3 times to about 5 times rather than efficiency of heat transfer is gas single phase. Since the rate of the gas section occupied in the high low voltage heat exchanger 25 since it will become easy to become a saturation gas refrigerant, if the inlet gas temperature of the high low voltage heat exchanger 25 falls decreases and the rate of the vapor-liquid two phase section increases conversely, the amount of heat exchange increases. Therefore, the operational status of the piping washing station 11 serves as operation to which high low voltage falls to and a refrigerant flow rate falls, as the gestalt 2 of operation described.

[0087] Drawing 21 is PH diagram showing change of the operation situation by the fan air-flow rate control of the above-mentioned syngas cooler 27, and in drawing, an axis of abscissa shows Enthalpy H, an axis of ordinate shows a pressure, and when a continuous line is syngas cooler fan airflow size, the case where a dotted line is syngas cooler fan airflow smallness is shown. If the fan airflow of a syngas cooler 27 is made to increase as the continuous line of drawing 21 shows, high low voltage will fall, a discharge temperature and an intake air temperature will fall, and the dryness fraction of the refrigerant which flows into the washed piping 4 will become low. According to such the control characteristic, fan control of a syngas cooler is carried out based on the desired value of a high-pressure pressure, a low voltage pressure, a discharge temperature, the degree of superheat of compressor 1 inhalation, and the dryness fraction of the refrigerant which flows into the washed piping 4, and the deflection of the current value, and it controls so that the value of a high-pressure pressure, a low voltage pressure, a discharge temperature, the degree of superheat of compressor 1 inhalation, and the dryness fraction of the refrigerant which flows into the washed piping 4 turns into a suitable value.

[0088] Thus, while securing a refrigerant flow rate required for washing and raising washing capacity by performing the operation control of the piping washing station 11, operation of a reliable piping washing station is realizable.

[0089] Gestalt 4. drawing 22 of operation is drawing showing the gestalt 4 of operation of this invention, and is the refrigerant circuit Fig. of a piping washing station. In drawing, 28 is heat souce and a refrigerant circuit consists of a compressor 1, an oil separator 2, a four way valve 29, a heat-source side heat exchanger 30, and an accumulator 10. 31 is a mineral oil recovery system and a refrigerant circuit consists of the high low voltage heat exchanger 25, an electronic expansion valve 7, a separation recovery system 9, and check valves 32a, 32b, 32c, and 32d. Moreover, they are the connection valve with which 12a and 12b connect the established piping 4 and 6 with the mineral oil recovery system 31, and the connection valve which connects the mineral oil recovery system 31 with heat souce 28 12c, 12d, 12e, and 12f.

[0090] The gestalt of this operation washes combining the heat souce 28 and the mineral oil recovery system 31 which are installed after exchange instead of. [the piping washing station 11 shown in drawing 13 or drawing 19] When it sets up so that a four way valve 29 may be passed in the direction of a continuous line, a refrigerant flows in the direction of a continuous-line arrow head in drawing, and the refrigerating cycle which consists of drawing 22 serves as the configuration as drawing 13 with the same circuitry, does so the same effectiveness as the gestalt 2 of above-mentioned operation, and becomes possible [performing washing similarly]. Moreover, when it sets up so that a four way valve 29 may be passed in the direction of a dotted-line arrow head, although the sequence of the heat-source side heat exchanger 30 equivalent to a syngas cooler 27 and the mineral oil recovery system 9 interchanges, it becomes the same circuitry as drawing 19 , and the same effectiveness as the gestalt 3 of above-mentioned operation is done so, and it becomes possible to perform piping washing similarly. After the completion of washing removes the mineral oil recovery system 31 and a by-path pipe 5, is connecting heat souce 28 and an interior unit to the established piping 4 and 6, and

completes washing of piping, and exchange of a frozen air conditioner.
[0091] Moreover, in drawing 22 , 15 [illegible]e measurement control unit of heat s[illegible] 28, and 33 is the measurement control unit of the mineral oil recovery system 31. In the operation control of piping washing operation, work of each measurement control unit is performed as follows. First, in the measurement control unit 15 of heat souce 28, the measured value according the discharge temperature of a compressor 1, an intake air temperature, a high-pressure pressure, and a low voltage pressure to temperature sensors 13a and 13c and pressure sensors 14a and 14b is obtained, and this information is transmitted to the measurement control unit 33 of the mineral oil recovery system 31. The temperature information on high low voltage heat exchanger 25 outlet measured by temperature sensor 13b which is the condensation side outlet side of a high low voltage heat exchanger, and was prepared in the washed piping inlet port in the measurement control unit 33 of the mineral oil recovery system 31, and the above-mentioned information transmitted from heat souce 28 are doubled. The control approach of a compressor 1, The fan airflow of the heat-source side heat exchanger 30, the amount of heat exchange of the high low voltage heat exchanger 25, While determining the opening of the electronic expansion valve 7 and directing the operation revolving speed control of a compressor 1, and the control approach of the fan (not shown) of the heat-source side heat exchanger 30 to the measurement control unit 15 of heat souce 28, the amount of heat exchange of the high low voltage heat exchanger 25 and opening of the electronic expansion valve 7 are controlled. In the measurement control unit 15 of heat souce 28, control implementation of the rotational frequency of a compressor 1 and the rotational frequency of the fan of the heat-source side heat exchanger 30 is carried out in response to the information from this mineral oil recovery system 31. On the other hand, the operation control of the heat souce 28 as a usual frozen air conditioner after removing the mineral oil recovery system 31 is carried out with the measurement control unit 15.
[0092] Thus, it is leaving the operation control under piping washing operation to the measurement control unit 33 of the mineral oil recovery system 31, and making the measurement control unit 15 of heat souce 28 specialize in the operation control of the heat souce 28 as a usual frozen air conditioner. Even if it is the heat souce which did not support originally the piping washing approach which is constituted by drawing 22 , piping washing operation can be carried out without being accompanied by big control modification, the width of face of the heat-souce application in the case of carrying out piping washing operation can be expanded, and versatility can be raised.
[0093] Moreover, it is very good in the gestalt shown in drawing 23 as another gestalt of the gestalt 4 of operation. Drawing 23 is drawing showing the refrigerant circuit Fig. of a piping washing station, in drawing, 36 is a control device and the same as that of drawing 22 or a considerable part attaches the same sign. It differs in that the control device 36 by which the refrigerant circuit of drawing 22 is the same, was prepared in the exterior in which both measurement control units 33 of the measurement control unit 15 of heat souce 28 and the mineral oil recovery system 31 and an information transmission are possible, and communication link connection was made was formed. A personal computer etc. is a portable migration terminal and a control device 36 has the function to transmit the measurement control unit 33 and information on the measurement control unit 15 of heat souce 28, and the function and heat souce 28 which can carry out the operation control of the mineral oil recovery system 31, and the mineral oil recovery system 31. The operation control under piping washing operation is carried out as follows. First, in the heat-source side measurement control unit 15 formed in heat souce 28, as mentioned above, the measured value of the operational status by the side of heat souce 15 is obtained from each pressure sensor and a temperature sensor, and this information is transmitted to a control device 36. Moreover, as mentioned above also with the washing side measurement control unit 33 formed in the mineral oil recovery system 31, the thermometry value of high low voltage heat exchanger 25 outlet measured by temperature sensor 13b is acquired, and this information is transmitted to a control device 36. In a control device 36, such operation information is acquired, the contents of control over each actuator in the mineral oil recovery systems 31, such as the contents of control over each actuator in the heat souce 28, such as a compressor 1, and the high low voltage heat exchanger 25, are determined, and it directs to carry out these control for which it opted to the measurement control units 15 and 33.
[0094] In addition, although direct continuation of the washing side measurement control unit 33 of a control device 36 and the mineral oil recovery system 31 is carried out and it serves as a control device 36, the heat-source side measurement control unit 15 of heat souce 28, and an information transmission form centering on a control device 36 further in drawing 23 Even if it gives a network function to each control unit and the washing side measurement control unit 33 of a control device 36, the measurement control unit 15 of heat souce 28 and a control device 36, and the mineral oil recovery system 31 is connected indirectly It is very good in the gestalt which can carry out an information transmission between a control device 36, the heat-source side measurement control unit 15 of heat souce 28 and a control device 36, and the washing side

measurement control unit 33 of the mineral oil recovery system 31. For example, a control device 36 and the heat-source side measurement control unit 15 of heat souce 28 are connected, the washing side measurement control unit 33 of this heat-source side measurement control unit 15 and the mineral oil recovery system 31 is connected, each control unit holds a network function, and if an information transmission is possible for the washing side measurement control unit 33 of a control device 36 and the mineral oil recovery system 31, acquisition of operation information which was mentioned above in the control device 36, and directions of an operation control can be performed.

[0095] Even if it is such a gestalt, the operation control under piping washing operation By making the heat-source side measurement control unit 15 of the above-mentioned heat souce 28 specialize in the operation control section which leaves to a control device 36 and the heat souce 28 as a usual frozen air conditioner has Even if it is the heat souce which does not correspond originally to the piping washing approach which is constituted by drawing 23 and which was not, piping washing operation can be carried out without following big control modification on the control unit which it has, the width of face of the heat-souce application in the case of carrying out piping washing operation can be expanded, and versatility can be raised. Moreover, if such a gestalt is taken when connection use is carried out and the mineral oil recovery system 31 must change the control approach of piping washing operation into the heat souce of various classes according to various heat souce 28, correspondence will become possible by changing the contents of control over the heat souce 28 and the mineral oil recovery system 31 which a control device 36 holds according to heat souce 28. For example, when a control device 36 is a personal computer, an operation control can be easily changed by changing suitably the control program performed on the occasion of piping washing operation. Therefore, by it becoming unnecessary to hold the operation-control approach under piping washing to the washing side measurement control device 33 of the mineral oil recovery system 31, and specializing in the drive of each actuator, more, versatility can be given and piping washing operation at the time of it becoming unnecessary to have changed the operation-control approach of the washing side measurement control device 33 of the mineral oil recovery system 31 according to heat souce 28, and using the mineral oil recovery system 31 can be carried out.

[0096] In addition, when piping washing operation is carried out with a gestalt as shown in drawing 22 and drawing 23 , informational transfer is performed between the washing side measurement control unit 33 of the heat-source side measurement control unit 15 of heat souce 28, and the mineral oil recovery system 31, or these and a control device 36. When transfer of this information does not work under the effect of a noise etc., operation information on heat souce 28 cannot be transmitted, or the command of control of actuators, such as the compressor 1 of heat souce 28, will be made. Thereby, the compressor 1 of heat souce 28 may perform abnormality operation, and may cause breakage of heat souce 28 by the fault rise of a pressure etc. So, when abnormalities are accepted in communication links between each measurement control unit and a control device, such as informational transfer, the compressor 1 of heat souce 28 is suspended promptly, and heat souce 28 is protected. When the heat-source side measurement control unit 31 of heat souce 28 detects abnormalities in a communication link -- the informational receipt which cannot acquire information from other control units, or transmitted cannot be obtained -- as the approach of protection, for example, operation of a compressor 1 is stopped and heat souce 28 is protected. Moreover, when [of the heat-source side measurement control unit 15 of heat souce 28, the washing side measurement control unit 33 of the mineral oil recovery system 31, and a control device 36] the abnormalities in a communication link are accepted in any one at least Display that it is a communication link abnormal condition on at least one of each of the control unit, the monitor who supervises piping washing operation is made to know, a monitor may operate the manual stop function of the compressor 1 beforehand formed in the measurement control unit 15 of heat souce 28, and a compressor 1 may be suspended. Thus, when informational transfer is not well performed between the washing side measurement control unit 33 of the heat-source side measurement control unit 15 of heat souce 28, and the mineral oil recovery system 31, and a control device 36, the compressor 1 of heat souce 28 is suspended promptly, and it is preventing breakage of the heat souce 28 by abnormality operation of heat souce 28, and it becomes possible to carry out more reliable piping washing operation.

[0097] Moreover, when piping washing operation is carried out with a gestalt as shown in drawing 22 and drawing 23 , To at least one of the heat-source side measurement control unit 15 of heat souce 28, the washing side measurement control unit 33 of the mineral oil recovery system 31, and the control devices 36 The information on refrigerants, such as the operation situation under piping washing operation, for example, the pressure measured during operation, and temperature, While displaying the advance situation of piping washing operations, such as completion, un-completing, etc., on a display, you may make it record using a storage means. [of the operation information on each actuators, such as operation of a compressor 1, old washing time amount or washing time amount required from now on, and piping washing operation] While can

check the operation situation under piping washing operation by carrying out such a display and the convenience of piping washing operation rises, the monitor of piping washing operation can supervise this operation situation, and piping washing operation can carry out certainly by redoing piping washing operation again or correcting the operation control of piping washing operation suitably, when it can judge that piping washing operation is not performed normally. Moreover, when a certain abnormalities occur during piping washing operation and operation stops by the advance situation of piping washing operation being recorded, the factor of record of an operation situation to shutdown becomes clear, and it becomes that it is possible in ensuring piping washing operation as coping with the factor. Moreover, when it stops in the place where piping washing operation advanced to some extent, the remaining piping washing operation time is drawn from record of an operation situation, and piping washing operation after a restart may be made to perform the parts for remaining operation time. The time amount of a piping washing activity can be shortened without only required sufficient time amount's performing piping washing, and performing useless piping washing operation beyond the need by performing such operation, compared with performing piping washing operation from the first stage again.

[0098] Moreover, when taking a gestalt as shown in drawing 22 and drawing 23 , it records completion or un-completing on the heat-source side measurement control unit 15 of heat souce 28, and when piping washing operation is not completed, operations other than piping washing operations, such as operation at the time, may be made to usually forbid in heat souce 28. [of piping washing operation] Even if it constitutes heat souce 28 and the mineral oil recovery system 31 so that piping washing operation may be carried out Piping washing operation is ended in the condition of piping washing operation not being carried out by some causes, such as an artificial mistake, or having not completed. Since operation as a usual frozen air conditioner may be performed using heat souce 28 and piping washing is not completed in this case, fault may be caused to operation of a frozen air conditioner by the inflow of the mineral oil which remains in established piping. So, when performing operations other than piping washing operation of performing operation as a usual frozen air conditioner using heat souce 28, completion of piping washing operation is surely recorded on the heat-source side measurement control unit 15 of heat souce 28. By doing in this way, when performing operations other than piping washing operations, such as operation as a usual frozen air conditioner, piping washing operation can be completed certainly, and a more reliable frozen air conditioner can be supplied.

[0099] Gestalt 5. drawing 24 of operation and drawing 25 are drawings showing the gestalt 5 of operation of this invention, and are drawing having shown the information flow under heat-souce operation under piping washing operation and after washing operation termination. In drawing 24 and 25, a frozen air conditioner is centralized-control equipment currently installed in the locations (for example, a frozen air-conditioner management contractor's service center etc.) by which remoteness was carried out, and 34 receives the operation information under heat-souce operation under piping washing station operation and after washing operation termination from the mineral oil recovery system 31 and the measurement control units 33 and 15 of heat souce 28. In drawing 25 , the temperature sensor with which 13d and 13e detect the coolant temperature in the use side heat exchanger 23, the temperature sensor which detects 13f of indoor air temperature in the use side heat exchanger 23, and 35 are the measurement control units of an interior unit 22. In addition, since the sign of drawing 24 and others of 25 is the same as that of the gestalten 1-4 of operation, explanation is omitted.

[0100] The measurement control unit of the interior unit 22 in drawing 25 While transmitting the information on the laying temperature set up by the frozen air-conditioner user, the coolant temperature in the use side heat exchanger 23, and indoor air temperature to the measurement control unit 15 of heat souce 28 The degree of superheat of the use side heat exchanger 23 or whenever [supercooling] are calculated based on the information transmitted from the measurement control unit 15 of heat souce 28, the opening of the electronic expansion valve 24 is determined based on the result of an operation, or the amount of heat exchange in the use side heat exchanger 23 is determined and controlled by fan airflow etc.

[0101] Moreover, drawing 26 is drawing showing the business and the information flow of a service maintenance in the case of the frozen air-conditioner exchange accompanied by piping washing. Hereafter, service and an information flow are explained based on drawing 26 . The frozen air-conditioner user 40 requests renewal of the frozen air conditioner 42 from the frozen air-conditioner management contractor 41 first (S1). Next, if the frozen air-conditioner management contractor 41 investigates the existing frozen air conditioner and the situation of established piping (S2), established piping washes and it judges that it is usable, a frozen air conditioner will be ordered from the frozen air-conditioner manufacturer 43 (S3), and piping washing construction and updating construction of a frozen air conditioner will be requested to (S4) and the construction contractor 44 to whom a frozen air conditioner is supplied (S5). About the mineral oil recovery system 31 shown in drawing 23 at this time, it is sold to the frozen air-conditioner management contractor 41

from the frozen air-conditioner manufacturer 43 (S6), and the frozen air-conditioner management contractor 41 directs the piping washing construction using this mineral oil recovery system 31 to the construction contractor 44. While the construction contractor 44 performs freezer installation work and is carrying out piping washing (S7), The heat souce 28 under piping washing operation and the operation information on the mineral oil recovery system 31 are transmitted to the centralized-control equipment 34 shown in drawing 23 in the frozen air-conditioner management contractor's 41 basis by the wire communication and radio by the telephone line or the Internet (S8). Management of the heat souce 28 under piping washing operation mentioned later and the mineral oil recovery system 31 is made using this centralized-control equipment 34 (S9).

[0102] And although the usual frozen air-conditioning operation is carried out using heat souce 28 as after piping washing is shown in drawing 25 , it is brought together in being [the operation information on the heat souce 28 at this time and an interior unit 22 / in the frozen air-conditioner management contractor's 41 basis] centralized-control equipment 34 (S8), and management of the heat souce 28 under operation is usually performed using centralized-control equipment 34 (S9). If maintenance construction is requested (S11) and maintenance components are supplied to the construction contractor 44 by the frozen air-conditioner manufacturer 43 while a certain fault is during piping washing operation and usual operation, and the frozen air-conditioner management contractor 41 orders maintenance components to the frozen air-conditioner manufacturer 43 (S10), when construction is required (S12), the construction contractor 44 will carry out maintenance construction (S13).

[0103] The gestalt of this operation explains the operation management method of the heat souce 28 under piping washing operation and after piping washing operation based on drawing 24 and drawing 25 . The management method under piping washing operation is first explained based on drawing 24 . In this case, the centralized-control equipment 34 by which remote installation was carried out from the construction site receives the operation information on heat souce 28 through the measurement control unit 33 of the mineral oil recovery system 31 while receiving the operation information on the mineral oil recovery system 31 from the measurement control unit 33 of the mineral oil recovery system 31. As information received at this time, they are control information, such as inlet temperature of the washed piping 4, the amount of heat exchange of the high low voltage heat exchanger 25, and opening of the electronic expansion valve 7, from the mineral oil recovery system 31. And information, such as control information of devices, such as the discharge temperature of a compressor 1, an intake air temperature and a high-pressure pressure under operation, a low voltage pressure and a rotational frequency of a compressor 1, and fan airflow of the heat-source side heat exchanger 30, and an electrical input at the time of equipment operation, is received from heat souce 28.

[0104] Next, with centralized-control equipment 34, it judges whether piping washing operation is performed appropriately based on the received information. And when it is judged that piping washing operation is not performed appropriately, operation control lead is given to the measurement control unit 33 of the mineral oil recovery system 31 so that it may operate appropriately. For example, when desired value suitable about the high-pressure pressure under piping washing operation, a low voltage pressure, a discharge temperature, the degree of superheat of compressor inhalation, and the dryness fraction of the refrigerant which flows into the washed piping 4 is not set up, the contents of control of piping washing shown in the gestalten 1-4 of above-mentioned operation are directed. Moreover, when it is judged that excess and deficiency are in the amount of refrigerants with which it fills up, it judges whether additional charge of what amount of refrigerants is carried out, or it collects, the construction contractor 44 who is carrying out installation and washing operation of a frozen air conditioner is contacted, and restoration or recovery of a refrigerant is directed. moreover, washing time amount more nearly required than operation information when it is judged that refrigerant flow rates required for washing run short, and many washing time amount is required rather than a schedule -- determining -- the -- it directs to carry out time amount washing operation to a construction contractor. Thus, the centralized-control equipment 34 installed in remoteness in the operation information in piping washing operation is used, and it can respond to information with fixed criteria because the management contractor 41 does unitary management, washing operation can be certainly carried out now, and while being able to carry out piping washing do not depend to a construction contractor's level of skill, the operation dependability of piping washing can be raised. Moreover, since a frozen air-conditioner management contractor can do directions of an activity from a remote service center, he can save each time and effort for which it installs and goes to a site, and he has the effectiveness which can also reduce the working hours of piping washing.

[0105] Next, based on drawing 25 , the management method of a frozen air conditioner while carrying out the frozen air-conditioning operation usual by heat souce 28 is explained after piping washing. In this case, centralized-control equipment 34 receives the operation information on heat souce 28 from the measurement

control unit 15 of heat souce 28. As information received at this time, information such as the discharge temperature of a compressor 1, an intake air temperature and the high-pressure pressure under operation, a low voltage pressure and the rotational frequency of a compressor 1, the fan airflow of the heat-source side heat exchanger 30 and the operation information on an interior unit, i.e., the air-conditioning laying temperature set up by the air-conditioner user and the coolant temperature in the use side heat exchanger 23, indoor air temperature, the amount of heat exchange of the use side heat exchanger 23, and opening of the electronic expansion valve 24, is received. Next, with centralized-control equipment 34, it judges whether operation of heat souce 28 is appropriately performed after piping washing operation based on the received information. And when piping washing is judged that operation of heat souce 28 is not performed appropriately by the reasons of having not worked, directions are given to the measurement control unit 15 of heat souce 28, or repair of heat souce 28 and an interior unit 22 is carried out so that it may operate appropriately.

[0106] For example, it sets that the opening of the electronic expansion valve 24 in an interior unit 22 is opened fully etc. in the situation currently opened greatly. The low voltage pressure is declining or [lower than the temperature the coolant temperature of the use side heat exchanger 23 at the time of air conditioning operation is assumed to be] or [higher than the temperature the coolant temperature of the use side heat exchanger 23 at the time of heating operation is assumed to be] or [higher than the value the degree of superheat of the use side heat exchanger 23 at the time of air conditioning operation is assumed to be] Or when it is said that it is higher than the value whenever [supercooling / of the use side heat exchanger 23 at the time of heating operation] is assumed to be, a part of electronic expansion valve 24 can judge that it is choked up with the residue which was not able to be washed at the time of piping washing, or the foreign matter mixed on the occasion of installation work.

[0107] In such a case, while centralized-control equipment 34 takes out directions to the measurement control unit 15 of heat souce 28 so that the opening of the electronic expansion valve 24 may be opened further when it is in the situation which the opening of the electronic expansion valve 24 still opens first, it emits the information that the electronic expansion valve 24 is poor, to the frozen air-conditioner management contractor 41. In order for the frozen air-conditioner management contractor 41 to see the information and to exchange the electronic expansion valve 24, a substitute part is ordered from the frozen air-conditioner manufacturer 43, and the frozen air-conditioner management contractor 41 or the construction contractor 44 exchanges the electronic expansion valve 24. Moreover, in order to investigate the cause of the defect at this time, the frozen air-conditioner management contractor 41 investigates the description of the refrigerating machine oil in heat souce 28, and when there is a problem, he does the management activity of refrigerating-machine-oil exchange etc.

[0108] Moreover, when the electrical input of the compressor 1 of heat souce 28 is larger than the input value of the compressor 1 predicted from the operation situation of a compressor, i.e., a high-pressure pressure, a low voltage pressure, a rotational frequency, and an intake air temperature, it can be judged that operation of a compressor 1 is a defect. When also in such a case the frozen air-conditioner management contractor 41 investigates the description of the refrigerating machine oil in heat souce 28 and there is a problem, refrigerating-machine-oil exchange etc. is worked. Moreover, by refrigerating-machine-oil exchange, when it cannot respond, it corresponds by exchange of a compressor 1 etc.

[0109] Thus, also in frozen air-conditioner operation after piping washing, it can respond to information with fixed criteria because a management contractor manages to 1 yuan using the centralized-control equipment by which installed the operation information and remote installation was carried out from the site, and the frozen air conditioner after piping washing can be certainly operated now, and the dependability in frozen air-conditioner operation can be raised.

[0110] In addition, the function of above centralized-control equipment 34 may be beforehand included in the measurement control unit 33 of the mineral oil recovery system 31, or the measurement control unit 15 of heat souce 28, and may be placed. In this case, the inside of washing operation, and when the matter which needs a cure is usually during operation, an abnormality signal is emitted in the measurement control units 15 and 33, according to this signal, the frozen air-conditioner management contractor 41 and the construction contractor 44 cope with maintenance, a prompt action can be performed to the caused abnormalities, and shortening of working hours is attained.

[0111]

[Effect of the Invention] The recovery system which the piping washing station concerning claim 1 of this invention connects a compressor, a condenser, expansion equipment, and an evaporator, washes the washed body with the refrigerant conveyed with said compressor, and collects washed objects, Since it had the control unit of the flow resistance of the heat exchange capacity of said condenser, and said expansion equipment, and the heat exchange capacity of said evaporator which controls any one at least so that the physical

condition of said refrigerant might serve as desired value defined beforehand While improving washing capacity, a piping washing station with high operation dependability can be offered.

[0112] Since the piping washing station concerning claim 2 of this invention controls a control unit so that the refrigerant which flows into the washed body serves as vapor-liquid two-phases flow, it can improve piping washing capacity.

[0113] The piping washing station concerning claim 3 of this invention equips inlet-side piping of a compressor with a low voltage pressure sensor, and since a control unit is controlled to become beyond the predetermined desired value as which the low voltage pressure detected by said low voltage pressure sensor was determined beforehand, it can offer a piping washing station with high operation dependability while it improves washing capacity.

[0114] The piping washing station concerning claim 4 of this invention equips discharge-side piping of a compressor with a high-pressure pressure sensor, and since a control unit is controlled to become beyond the predetermined desired value as which the high-pressure pressure detected by said high-pressure pressure sensor was determined beforehand, it can offer a piping washing station with high operation dependability while it improves washing capacity.

[0115] The piping washing station concerning claim 5 of this invention equips discharge-side piping of a compressor with a discharge-temperature sensor, and since a control unit is controlled to become below the predetermined desired value as which the discharge temperature detected by said discharge-temperature sensor was determined beforehand, it can offer a piping washing station with high operation dependability while it improves washing capacity.

[0116] The piping washing station concerning claim 6 of this invention equips inlet-side piping of a compressor with a low voltage pressure sensor and an intake-air-temperature sensor, and since a control unit is controlled so that the inhalation degree of superheat computed by the intake air temperature detected from the low voltage pressure detected from said low voltage pressure sensor and said intake-air-temperature sensor serves as predetermined desired value defined beforehand, it can offer a piping washing station with high operation dependability while it improves washing capacity.

[0117] The piping washing station concerning claim 7 of this invention equips discharge-side piping of a compressor with a condensation outlet temperature sensor at outlet side piping of a high-pressure pressure sensor and a condenser. Since a control unit is controlled to become the predetermined target range where the dryness fraction of the two phase refrigerant computed from the condenser outlet temperature detected from the high-pressure pressure detected from said high-pressure pressure sensor and said condensation outlet temperature sensor was defined beforehand While improving washing capacity, a piping washing station with high operation dependability can be offered.

[0118] Since the piping washing station concerning claim 8 of this invention prepared the high low voltage heat exchanger which carries out heat exchange of a part or all of the heat of condensation of a refrigerant that is obtained with a condenser as evaporation heat in an evaporator, a piping washing station is made as for it to a compact.

[0119] Since the amount of heat exchange of a high low voltage heat exchanger is changed so that the physical condition of a refrigerant may serve as desired value defined beforehand, the piping washing station concerning claim 9 of this invention can offer a piping washing station with high operation dependability while improving washing capacity.

[0120] Since it has a gas cooling means to cool the refrigerant which flows out of a high low voltage heat exchanger and which evaporated and the refrigeration capacity of said gas cooling means is changed according to the physical condition of a refrigerant, the piping washing station concerning claim 10 of this invention can offer a piping washing station with high operation dependability while improving washing capacity.

[0121] Since the driving ability of a compressor is adjustable, the piping washing station concerning claim 11 of this invention can offer a piping washing station with high operation dependability while improving washing capacity.

[0122] Since it determines the control-objectives value of the physical condition of a refrigerant according to the driving ability of a compressor, the piping washing station concerning claim 12 of this invention can offer a piping washing station with high operation dependability while improving washing capacity.

[0123] Since it determines the control-objectives value of the physical condition of a refrigerant according to the flow resistance of the washed body, the piping washing station concerning claim 13 of this invention can offer a piping washing station with high operation dependability while improving washing capacity.

[0124] Since it determines the control-objectives value of the physical condition of a refrigerant according to the ambient temperature of a piping washing station, the piping washing station concerning claim 14 of this invention can offer a piping washing station with high operation dependability while improving washing capacity.

[0125] The piping washing station concerning claim 15 of this invention While having the heat exchanger which makes either condense at least the refrigerant of said heat souce or said piping washing station breathed out from said compressor in the piping washing station connected with the heat souce which has a compressor between washed piping The expansion equipment which makes said piping washing station decompress the refrigerant condensed by said heat exchanger, Since it had the washed object recovery means which carries out separation recovery of the washed object from the refrigerant which circulated said washed piping, and the washing side control unit whose transmission of operation information is enabled from the heat-source side control unit which said heat souce has Piping washing operation can be performed without also accompanying the heat souce which is not having piping washing taken into consideration from the first by big control modification, the width of face of this heat-souce application can be expanded, and versatility can be raised.
[0126] Since a washing side control unit controls any one at least according to the operational status of heat souce among the amount of heat exchange of a heat exchanger, the amount of drawing of expansion equipment, or the operation capacity of a compressor, the piping washing station concerning claim 16 of this invention can improve washing capacity.
[0127] The piping washing station concerning claim 17 of this invention In the piping washing station connected with the heat souce which has the heat-source side control unit whose transmission of operation information is enabled at the control device arranged in a compressor and the exterior between washed piping While having the heat exchanger which makes the refrigerant of heat souce or a piping washing station breathed out by either from the compressor at least condense The expansion equipment which makes a piping washing station decompress the refrigerant condensed by the heat exchanger, Since it had the washed object recovery means which carries out separation recovery of the washed object from the refrigerant which circulated washed piping, and the washing side control unit whose transmission of operation information is enabled between a heat-source side control unit or/and a control device While being able to perform piping washing operation, being able to expand the width of face of this heat-souce application and being able to raise versatility, without also accompanying the heat souce which is not having piping washing taken into consideration from the first by big control modification Piping washing operation can be performed without being accompanied by big control modification corresponding to heat souce also in a piping washing station, the width of face of this heat-souce application can be expanded, and versatility can be raised.
[0128] Since a control device controls any one at least according to the operational status of heat souce and a piping washing station among the amount of heat exchange of a heat exchanger, the amount of drawing of expansion equipment, or the operation capacity of a compressor, the piping washing station concerning claim 18 of this invention can improve washing capacity.
[0129] The piping washing station concerning claim 19 of this invention When fault occurs in transmission of the operation information between the control device arranged between the heat-source side control unit which heat souce had, and the control units which the piping washing station had, or in the exterior, said heat-source side control unit, and said washing side control unit Since the heat-source side control unit was equipped with the function to suspend operation of the compressor arranged in said heat souce, the heat-souce breakage by abnormality operation under piping washing operation can be prevented, and a reliable frozen air conditioner can be obtained.
[0130] Since it had the storage means or a display means display of a heat-source side control unit, a washing side control unit, or a control device record the advance situation of piping washing operation on any one at least, while can check an operation situation and the convenience of piping washing operation rises during piping washing operation, in the piping washing station concerning claim 20 of this invention, the correspondence when the ability of piping washing operation to be fully unable to carry out can carry out piping washing operation to collapsibility authenticity easily.
[0131] Since the piping washing station concerning claim 21 of this invention records completion or un-completing on the storage means of a heat-source side control unit, a washing side control unit, or a control device which it had in any one at least, it can check the operation situation of piping washing operation, and can raise the convenience of piping washing operation. [of piping washing operation]
[0132] When interrupted at un-completing in piping washing operation, since it holds to either at least, required sufficient thing do for die-length operation becomes possible about the operation time of piping washing operation, and the piping washing station concerning claim 22 of this invention becomes that the thing of a washing side control unit or a control device for which piping washing operation is carried out appropriately is possible about the function of resuming piping washing operation based on record of the advance situation of piping washing operation.
[0133] Since the piping washing station concerning claim 23 of this invention forbids operations other than piping washing operation in heat souce when completion record of piping washing operation is not made by the

heat-source side control unit, at the time of piping washing operation un-completing, it is lost and carrying out operation usually used in established piping, such as operation, can obtain a reliable frozen air conditioner in it.
[0134] The piping washing approach concerning claim 24 of this invention The step which removes the frozen air conditioner of established use from established piping, and the step which attaches a piping washing station in said established piping, Since it had the step which judges the fitness of said piping washing operation based on the information on the operational status of said piping washing station transmitted to the centralized-control equipment by which remote installation was carried out from the step which performs piping washing operation with said piping washing station, and the control unit formed in said piping washing station The operation information in piping washing operation can be managed to 1 yuan, it can respond on fixed criteria, and the reliable frozen air conditioner independent of the level of skill of a piping washing activity can be obtained.
[0135] Since the piping washing approach concerning claim 25 of this invention was equipped with the step which makes a change of an operation control condition or the amount adjustment of refrigerants by the fitness judging of piping washing operation, the effectiveness of reduction of a frozen air-conditioner management contractor's time and effort or piping washing working hours is acquired.

[Translation done.]

* NOTICES *

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damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the refrigerant circuit Fig. of the piping washing station concerning the gestalt 1 of operation of this invention.
[Drawing 2] It is drawing showing the amount of piping survival of mineral oil and the relation of washing time amount concerning the gestalt 1 of operation of this invention.
[Drawing 3] It is drawing showing the refrigerant flow rate of a compressor and the relation of a compressor rotational frequency concerning the gestalt 1 of operation of this invention.
[Drawing 4] It is drawing showing the relation between the dryness fraction of a refrigerant, and temperature concerning the gestalt 1 of operation of this invention.
[Drawing 5] It is drawing showing other gestalten of the condenser concerning the gestalt 1 of operation of this invention, and an evaporator.
[Drawing 6] It is drawing showing other gestalten of the condenser concerning the gestalt 1 of operation of this invention, and an evaporator.
[Drawing 7] It is the sectional view showing the configuration of the piping washing station and condenser concerning the gestalt 1 of operation of this invention.
[Drawing 8] It is drawing showing the installation approach of the cover in the piping washing station concerning the gestalt 1 of operation of this invention.
[Drawing 9] It is drawing showing other examples of the installation approach of the cover in the piping washing station concerning the gestalt 1 of operation of this invention.
[Drawing 10] It is drawing showing other examples of the installation approach of the cover in the piping washing station concerning the gestalt 1 of operation of this invention.
[Drawing 11] It is drawing showing other gestalten using the electronic expansion valve concerning the gestalt 1 of operation of this invention.
[Drawing 12] It is the refrigerant circuit Fig. showing other gestalten of the piping washing station concerning the gestalt 1 of operation of this invention.
[Drawing 13] It is the refrigerant circuit Fig. of the piping washing station in which the gestalt 2 of operation of

this invention is shown.
[Drawing 14] It is drawing showing the gestalt of the high low voltage heat exchanger in the gestalt 2 of operation of this invention.
[Drawing 15] It is drawing showing the operation situation of the piping washing station in the gestalt 2 of operation of this invention.
[Drawing 16] It is drawing showing the operation situation at the time of the amount change of heat exchange of the high low voltage heat exchanger of the piping washing station in the gestalt 2 of operation of this invention.
[Drawing 17] It is drawing showing the operation situation at the time of outside-air-temperature change of the piping washing station in the gestalt 2 of operation of this invention.
[Drawing 18] It is drawing showing other gestalten of the high low voltage heat exchanger in the gestalt 2 of operation of this invention.
[Drawing 19] It is the refrigerant circuit Fig. of the piping washing station in which the gestalt 3 of operation of this invention is shown.
[Drawing 20] It is drawing showing the operation situation of the piping washing station in the gestalt 3 of operation of this invention.
[Drawing 21] It is drawing showing the operation situation at the time of syngas cooler fan airflow change of the piping washing station in the gestalt 3 of operation of this invention.
[Drawing 22] It is the refrigerant circuit Fig. of the piping washing station in which the gestalt 4 of operation of this invention is shown.
[Drawing 23] It is the refrigerant circuit Fig. of another piping washing station in the gestalt 4 of operation of this invention.
[Drawing 24] It is the refrigerant circuit Fig. of the piping washing station in which the gestalt 5 of operation of this invention is shown.
[Drawing 25] It is the refrigerant circuit Fig. of the frozen air conditioner concerning the gestalt 5 of operation of this invention.
[Drawing 26] It is drawing showing the contents of service at the time of renewal of a frozen air conditioner in the gestalt 5 of operation of this invention.
[Drawing 27] It is the refrigerant circuit Fig. of the conventional frozen air conditioner.
[Drawing 28] It is the related diagram of critical solubility showing the solubility of the refrigerating machine oil for HFC at the time of the conventional refrigerating-machine-oil (mineral oil) mixing, and a HFC refrigerant.
[Description of Notations]
1 Compressor, 2 Piping Oil Separator, 3 (Existing Piping) 4 Condenser, 6 Connecting piping, washed piping, 5 A by-path pipe, 7 An electronic expansion valve, 8 Evaporator, 9 A separation recovery system, 10 An accumulator, 10a Oil returning hole, 11 A piping washing station, 12a, 12b, 12c, 12d, 12e, 12f Connection valve, 13a, 13b, 13c, 13d, 13e A temperature sensor, 14a, 14b Pressure sensor, 15 A measurement control device, 16 A valve, 17 Bypass piping, 18 Open air inlet port, 19 An open air outlet, 20 It covers and is 21. An air course, 22 interior units, 23 Use side heat exchanger, 24 An electronic expansion valve, 25 A quantity low voltage heat exchanger, 26 A double pipe, 27 Syngas cooler, 28 Heat souce, 29 A four way valve, 30 A heat-source side heat exchanger, 31 Mineral oil recovery system, 32a, 32b, 32c, 32d A check valve, 33 (washing side) A measurement control unit, 34 Centralized-control equipment, 35 (heat-source side) A measurement control unit, 36 Control device.

[Translation done.]

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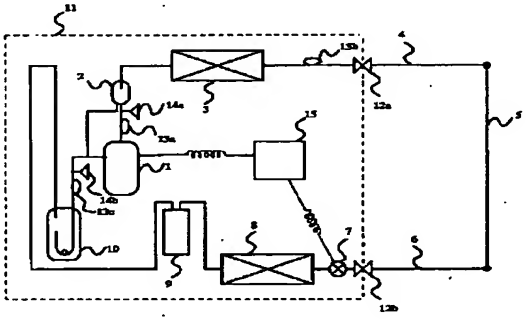
最終頁に続く

(54)【発明の名称】　配管洗浄装置および配管洗浄方法

(57)【要約】
【課題】　環境上問題のある塩素分を含む洗浄冷媒を用いて既設配管の洗浄を行なうことは環境汚染や洗浄処理に時間を要する問題がある。
【解決手段】　塩素分を含まない冷媒を用いた冷凍サイクルの洗浄装置を使用し、被洗浄配管に供給される冷媒流量を多くする、あるいは被洗浄配管に供給される冷媒の温度を高くする、あるいは被洗浄配管に供給される冷媒を二相冷媒となるように洗浄装置の運転を制御する。また、洗浄装置を熱源機と配管接続すると共に運転情報を伝送可能とする。



【特許請求の範囲】

【請求項１】　圧縮機、凝縮器、膨張装置、蒸発器を接続し、前記圧縮機で搬送される冷媒によって被洗浄体を洗浄して被洗浄物を回収する回収装置と、前記冷媒の物理状態が予め定められた目標値となるように、前記凝縮器の熱交換能力、前記膨張装置の流動抵抗及び前記蒸発器の熱交換能力の少なくともいずれか１つを制御する制御装置とを備えたことを特徴とする配管洗浄装置。

【請求項２】　前記制御装置は前記被洗浄体に流入する冷媒が気液二相流となるように制御することを特徴とする請求項１に記載の配管洗浄装置。

【請求項３】　前記圧縮機の吸入側配管に低圧圧力センサを備え、前記低圧圧力センサにより検知される低圧圧力が予め定められた所定目標値以上となるように制御装置を制御することを特徴とする請求項１または請求項２に記載の配管洗浄装置。

【請求項４】　前記圧縮機の吐出側配管に高圧圧力センサを備え、前記高圧圧力センサにより検知される高圧圧力が予め定められた所定目標値以上となるように制御装置を制御することを特徴とする請求項１または請求項２に記載の配管洗浄装置。

【請求項５】　前記圧縮機の吐出側配管に吐出温度センサを備え、前記吐出温度センサにより検知される吐出温度が予め定められた所定目標値以下となるように制御装置を制御することを特徴とする請求項１または請求項２に記載の配管洗浄装置。

【請求項６】　前記圧縮機の吸入側配管に低圧圧力センサおよび吸入温度センサを備え、前記低圧圧力センサから検知される低圧圧力と前記吸入温度センサから検知される吸入温度により算出される吸入過熱度が予め定められた所定目標値となるように制御装置を制御することを特徴とする請求項１または請求項２に記載の配管洗浄装置。

【請求項７】　前記圧縮機の吐出側配管に高圧圧力センサと前記凝縮器の出口側配管に凝縮出口温度センサを備え、前記高圧圧力センサから検知される高圧圧力と前記凝縮出口温度センサから検知される凝縮器出口温度から算出される二相冷媒の乾き度が予め定められた所定目標範囲となるように制御装置を制御することを特徴とする請求項２に記載の配管洗浄装置。

【請求項８】　前記凝縮器で得られる冷媒の凝縮熱の一部または全部を蒸発器における蒸発熱として熱交換する高低圧熱交換器を設けたことを特徴とする請求項１または２に記載の配管洗浄装置。

【請求項９】　前記冷媒の物理状態が予め定められた目標値となるように、高低圧熱交換器の熱交換量を変化させることを特徴とする請求項８に記載の配管洗浄装置。

【請求項１０】　前記高低圧熱交換器から流出する蒸発した冷媒を冷却するガス冷却手段を備え、前記ガス冷却手段の冷却能力を前記冷媒の物理状態に応じて変化させることを特徴とする請求項８に記載の配管洗浄装置。

【請求項１１】　前記圧縮機の運転能力が可変であることを特徴とする請求項１乃至請求項１０のいずれかに記載の配管洗浄装置。

【請求項１２】　前記圧縮機の運転能力に応じて冷媒の物理状態の制御目標値を決めることを特徴とする請求項１１に記載の配管洗浄装置。

【請求項１３】　前記被洗浄体の流動抵抗に応じて冷媒の物理状態の制御目標値を決めることを特徴とする請求項１乃至請求項１２のいずれかに記載の配管洗浄装置。

【請求項１４】　前記配管洗浄装置の周囲温度に応じて冷媒の物理状態の制御目標値を決めることを特徴とする請求項１乃至請求項１３のいずれかに記載の配管洗浄装置。

【請求項１５】　圧縮機を有する熱源機と被洗浄配管の間に接続される配管洗浄装置において、前記熱源機または前記配管洗浄装置の少なくともどちらか一方に前記圧縮機から吐出された冷媒を凝縮させる熱交換器を備えると共に、前記配管洗浄装置に、前記熱交換器により凝縮された冷媒を減圧させる膨張装置と、前記被洗浄配管を流通した冷媒から被洗浄物を分離回収する被洗浄物回収手段と、前記熱源機が有する熱源側制御装置から運転情報を伝送可能とする洗浄側制御装置とを備えたことを特徴とする配管洗浄装置。

【請求項１６】　洗浄側制御装置は、熱源機の運転状態に応じて熱交換器の熱交換量または膨張装置の絞り量または圧縮機の運転容量のうち少なくともいずれか１つを制御することを特徴とする請求項１５に記載の配管洗浄装置。

【請求項１７】　圧縮機と外部に配設した運転制御装置に運転情報を伝送可能とする熱源側制御装置を有する熱源機と被洗浄配管の間に接続される配管洗浄装置において、前記熱源機または前記配管洗浄装置の少なくともどちらか一方に前記圧縮機から吐出された冷媒を凝縮させる熱交換器を備えると共に、前記配管洗浄装置に、前記熱交換器により凝縮された冷媒を減圧させる膨張装置と、前記被洗浄配管を流通した冷媒から被洗浄物を分離回収する被洗浄物回収手段と、前記熱源側制御装置または／および前記運転制御装置の間で運転情報を伝送可能にする洗浄側制御装置とを備えたことを特徴とする配管洗浄装置。

【請求項１８】　運転制御装置は、熱源機および配管洗浄装置の運転状態に応じて熱交換器の熱交換量または膨張装置の絞り量または圧縮機の運転容量のうち少なくともいずれか１つを制御することを特徴とする請求項１７に記載の配管洗浄装置。

【請求項１９】　熱源機が有した熱源側制御装置と配管洗浄装置が有した洗浄側制御装置の間、あるいは外部に配設した運転制御装置と前記熱源側制御装置と前記洗浄側制御装置との間における運転情報の伝送に不具合が発

生したときに、前記熱源機に配設された圧縮機の運転を停止する機能を熱源側制御装置に備えたことを特徴とする請求項１５乃至請求項１８のいずれかに記載の配管洗浄装置。

【請求項２０】　熱源側制御装置、洗浄側制御装置または運転制御装置の少なくともいずれか１つに配管洗浄運転の進行状況を記録する記憶手段もしくは表示する表示手段を備えたことを特徴とする請求項１５乃至請求項１８のいずれかに記載の配管洗浄装置。

【請求項２１】　熱源側制御装置、洗浄側制御装置または運転制御装置の少なくともいずれか１つに有した記憶手段に配管洗浄運転の完了もしくは未完了を記録することを特徴とする請求項１５乃至請求項１８のいずれかに記載の配管洗浄装置。

【請求項２２】　配管洗浄運転が未完了で中断した場合に、配管洗浄運転の進行状況の記録をもとに配管洗浄運転を再開する機能を洗浄側制御装置または運転制御装置の少なくともどちらか一方に備えたことを特徴とする請求項２０に記載の配管洗浄装置。

【請求項２３】　熱源側制御装置に配管洗浄運転の完了記録がなされていない場合、熱源機において配管洗浄運転以外の運転を禁止することを特徴とする請求項２１に記載の配管洗浄装置。

【請求項２４】　既設使用の冷凍空調装置を既設配管から取り除くステップと、前記既設配管に配管洗浄装置を取り付けるステップと、前記配管洗浄装置により配管洗浄運転を行なうステップと、前記配管洗浄装置に設けた制御装置から遠隔設置された集中管理装置へ伝送される前記配管洗浄装置の運転状態の情報をもとに前記配管洗浄運転の適性を判断するステップとを備えたことを特徴とする配管洗浄方法。

【請求項２５】　前記配管洗浄運転の適性判定により、運転制御条件または冷媒量調整の変更を行なうステップを備えたことを特徴とする請求項２４に記載の配管洗浄方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、配管の洗浄装置に関するものであり、特に冷凍空調装置において使用する冷媒を交換すると同時に冷凍機油も交換する場合の配管に残留する冷凍機油を洗浄する洗浄装置に関するものである。

【０００２】

【従来の技術】従来から一般に用いられているセパレート形の冷凍空調装置を図２７に示す。図２７において、２８は熱源機であり、圧縮機１、四方弁２９，熱源側熱交換器３０、第１の接続弁１２ｃ、第２の接続弁１２ｄ、アキュムレータ１０を内蔵している。２２は室内機であり、電子膨張弁２４、及び利用側熱交換器２３を備えている。熱源機２８と室内機２２は離れた場所に設置され、第１の接続配管４、第２の接続配管６により接続されて、冷凍サイクルを形成する。

【０００３】第１の接続配管４の一端は四方弁２９と第１の接続弁１２ｃを介して接続され、第１の接続配管４の他の一端は利用側熱交換器２３と接続されている。第２の接続配管６の一端は熱源側熱交換器３０と第２の接続弁１２ｄを介して接続され、第２の接続配管６の他の一端は電子膨張弁２４と接続されている。また、アキュムレータ１０のU字管状の流出配管の下部には返油穴１０ａが設けられている。

【０００４】この冷凍空調装置の冷媒の流れを図２７にて説明する。図中、実線矢印が冷房運転の流れを、波線矢印が暖房運転の流れを示す。まず、冷房運転の流れを説明する。圧縮機１で圧縮された高温高圧のガス冷媒は四方弁２９を経て、熱源側熱交換器３０へと流入し、ここで空気・水など熱源媒体と熱交換して凝縮液化する。凝縮液化した冷媒は第２の接続弁１２ｄ、第２の接続配管６を経て電子膨張弁２４へ流入し、ここで低圧まで減圧されて低圧気液二相状態となり、利用側熱交換器２３で空気などの利用側媒体と熱交換して蒸発・ガス化する。蒸発ガス化した冷媒は第１の接続配管４、第１の接続弁１２ｃ、四方弁２９、アキュムレータ１０を経て圧縮機１へ戻る。

【０００５】次に暖房運転の流れを説明する。圧縮機１で圧縮された高温高圧のガス冷媒は四方弁２９，第１の接続弁１２ｃ、第１の接続配管４を経て、利用側熱交換器２３へと流入し、ここで空気など利用側媒体と熱交換して凝縮液化する。凝縮液化した冷媒は電子膨張弁２４へと流入し、ここで低圧まで減圧されて低圧気液二相状態となり、第２の接続配管６、第２の接続弁１２ｄを経て、熱源側熱交換器３０で空気・水などの熱源媒体と熱交換して蒸発・ガス化する。蒸発・ガス化した冷媒は四方弁２９、アキュムレータ１０を経て圧縮機１へ戻る。

【０００６】従来、このような冷凍空調装置の多くにはＣＦＣ（クロロフルオロカーボン）系冷媒やＨＣＦＣ（ハイドロクロロフルオロカーボン）系冷媒が用いられてきたが、これらの分子に含まれる塩素が成層圏でオゾン層を破壊するため、ＣＦＣ系冷媒は既に全廃され、ＨＣＦＣ系冷媒も生産規制が開始されている。

【０００７】これらに替わって、分子に塩素を含まないＨＦＣ（ハイドロフルオロカーボン）系冷媒を使用する冷凍空調装置が実用化されている。ＣＦＣ系冷媒やＨＣＦＣ系冷媒を用いた冷凍空調装置が老朽化した場合、これらの冷媒は全廃・生産規制されているため、ＨＦＣ系冷媒を用いた冷凍空調装置等に入れ替える必要がある。

【０００８】冷凍空調装置が熱源機２８と室内機２２およびこれらを接続する接続配管４と６で構成されるセパレート型であった場合、熱源機２８と室内機２２は、ＨＦＣ系冷媒で使用する冷凍機油・有機材料・熱交換器がＨＣＦＣ系冷媒やＣＦＣ系冷媒のそれらとは異なるた

め、ＨＦＣ系冷媒専用のものと交換する必要がある。さらに元々ＣＦＣ系冷媒やＨＣＦＣ系冷媒用の熱源機２８と室内機２２は老朽化しているため交換する必要があるものであり、交換も比較的容易である。

【０００９】一方、接続配管４、６については、配管長が長い場合や、パイプシャフトあるいは天井裏など建物に埋設されている場合、新規配管に交換することは困難で、しかも老朽化しにくいため、ＣＦＣ系冷媒やＨＣＦＣ系冷媒を用いた冷凍サイクル装置で使用していた接続配管４、６をそのまま使用できれば、配管工事が簡略化できる。

【００１０】

【発明が解決しようとする課題】しかし、ＣＦＣ系冷媒やＨＣＦＣ系冷媒を用いた冷凍空調装置で使用していた接続配管４、６には、ＣＦＣ系冷媒やＨＣＦＣ系冷媒を用いた冷凍空調装置の冷凍機油である鉱油が残留している。

【００１１】図２８は、鉱油混入時のＨＦＣ系冷媒用冷凍機油とＨＦＣ系冷媒（Ｒ４０７Ｃ）との溶解性を示す臨界溶解度曲線を示す図で、横軸は油量（ｗｔ％）、縦軸は温度（℃）を示す。冷凍機油は冷媒と混在している場合、冷媒に溶解して相溶する状態と溶解せず分離する状態とがあり、相溶と分離の境界点は温度に依存している。相溶する範囲は下限温度と上限温度に挟まれた温度域にあり、その溶解特性が図２８の臨界溶解度曲線にて表されている。ＨＦＣ系冷媒を用いた冷凍空調装置の冷凍機油（エステル油やエーテル油などの合成油）に鉱油が混入し、その鉱油量が増加するにつれて相溶する温度範囲が狭くなる。そして一定量以上混入すると、図２８に示すように、ＨＦＣ系冷媒との相容性が失われ、アキュムレータ１０に液冷媒が貯まっている場合にＨＦＣ系冷媒用冷凍機油が液冷媒の上層に分離・浮遊するため、アキュムレータ１０の下部にある返油穴１０ａから圧縮機１へ冷凍機油が戻らず圧縮機１の摺動部が焼き付く恐れがある。また、従来のＣＦＣ系冷媒では、潤滑油に鉱油が用いられていたのに対し、ＨＦＣ系冷媒では潤滑油に合成油が用いられているので、鉱油が既設冷媒配管に残存していると、新設の冷媒回路において、異物（コンタミネーション）が生じ、絞り機構を閉塞したり、圧縮機を損傷するという問題があった。

【００１２】また前記問題に対応して従来ではＣＦＣ系冷媒やＨＣＦＣ系冷媒を用いた冷凍空調装置で使用していた接続配管４、６を、洗浄装置を用いて鉱油を溶解する専用の洗浄液（ＨＣＦＣ１４１ｂやＨＣＦＣ２２５）で液封させ、配管中に残存する鉱油を溶解洗浄することが行われている。

【００１３】この場合には以下に示すような問題があった。第１に使用する洗浄液がＨＣＦＣ系冷媒であり、オゾン破壊係数が０でないため、冷凍空調装置の冷媒をＨＣＦＣ系冷媒からＨＦＣ系冷媒へと代替することと矛盾する。特に、ＨＣＦＣ１４１ｂはオゾン破壊係数が０．１１と大きく、この冷媒を使用して配管を洗浄することは問題である。

【００１４】また第２に、使用する洗浄液は可燃性・毒性が完全に安全なものではないことがあげられる。ＨＣＦＣ１４１ｂは可燃性で、低毒性であり、また、ＨＣＦＣ２２５は不燃性だが、低毒性である。

【００１５】さらに第３に洗浄液の沸点が高いため（ＨＣＦＣ１４１ｂは３２℃、ＨＣＦＣ２２５は５１～５６℃）洗浄後の洗浄液が蒸発しにくく配管に付着したままで、これらを回収するためには窒素ガスで洗浄液をブローして洗浄するなど、回収行程に時間を要する。

【００１６】また前記のような環境上の問題のない、または回収しやすい洗浄液を用いて洗浄を行おうとしても、このような洗浄液で鉱油に溶解性のあるものはほとんど存在しないため、洗浄が速やかに行われないという問題があった。

【００１７】この発明は、このような問題点を解消するためになされたものであり、配管の洗浄を迅速にかつ環境に支障なく行える洗浄装置を得るとともに、冷凍空調装置において使用する冷媒を交換するために装置の更新を行なうときに配管の洗浄を行ない、洗浄した既設配管を用いることで配管の再設置工事を簡略化する冷凍空調装置を提供することを目的とする。また、この発明は冷凍空調用熱源機を用いた配管洗浄運転による汎用性や洗浄作業の確実な完了を得ると共に、冷媒の入れ替えが簡単で信頼性の高い冷凍空調装置の取替え方法を得ることを目的とするものである。

【００１８】

【課題を解決するための手段】本発明の請求項１に係わる配管洗浄装置は、圧縮機、凝縮器、膨張装置、蒸発器を接続し、前記圧縮機で搬送される冷媒によって被洗浄体を洗浄して被洗浄物を回収する回収装置と、前記冷媒の物理状態が予め定められた目標値となるように、前記凝縮器の熱交換能力、前記膨張装置の流動抵抗及び前記蒸発器の熱交換能力の少なくともいずれか１つを制御する制御装置とを備えたものである。

【００１９】本発明の請求項２に係わる配管洗浄装置は、制御装置が前記被洗浄体に流入する冷媒を気液二相流となるように制御装置により制御するものである。

【００２０】本発明の請求項３に係わる配管洗浄装置は、圧縮機の吸入側配管に低圧圧力センサを備え、前記低圧圧力センサにより検知される低圧圧力が予め定められた所定目標値以上となるように制御装置を制御するものである。

【００２１】本発明の請求項４に係わる配管洗浄装置は、圧縮機の吐出側配管に高圧圧力センサを備え、前記高圧圧力センサにより検知される高圧圧力が予め定められた所定目標値以上となるように制御装置を制御するものである。

【００２２】本発明の請求項５に係わる配管洗浄装置は、圧縮機の吐出側配管に吐出温度センサを備え、前記吐出温度センサにより検知される吐出温度が予め定められた所定目標値以下となるように制御装置を制御するものである。

【００２３】本発明の請求項６に係わる配管洗浄装置は、圧縮機の吸入側配管に低圧圧力センサおよび吸入温度センサを備え、前記低圧圧力センサから検知される低圧圧力と前記吸入温度センサから検知される吸入温度により算出される吸入過熱度が予め定められた所定目標値となるように制御装置を制御するものである。

【００２４】本発明の請求項７に係わる配管洗浄装置は、圧縮機の吐出側配管に高圧圧力センサと凝縮器の出口側配管に凝縮出口温度センサを備え、前記高圧圧力センサから検知される高圧圧力と前記凝縮出口温度センサから検知される凝縮器出口温度から算出される二相冷媒の乾き度が予め定められた所定目標範囲となるように制御装置を制御するものである。

【００２５】本発明の請求項８に係わる配管洗浄装置は、凝縮器で得られる冷媒の凝縮熱の一部または全部を蒸発器における蒸発熱として熱交換する高低圧熱交換器を設けたものである。

【００２６】本発明の請求項９に係わる配管洗浄装置は、冷媒の物理状態が予め定められた目標値となるように、高低圧熱交換器の熱交換量を変化させるものである。

【００２７】本発明の請求項１０に係わる配管洗浄装置は、高低圧熱交換器から流出する蒸発した冷媒を冷却するガス冷却手段を備え、前記ガス冷却手段の冷却能力を冷媒の物理状態に応じて変化させるものである。

【００２８】本発明の請求項１１に係わる配管洗浄装置は、圧縮機の運転能力が可変であるものである。

【００２９】本発明の請求項１２に係わる配管洗浄装置は、圧縮機の運転能力に応じて冷媒の物理状態の制御目標値を決めるものである。

【００３０】本発明の請求項１３に係わる配管洗浄装置は、被洗浄体の流動抵抗に応じて冷媒の物理状態の制御目標値を決めるものである。

【００３１】本発明の請求項１４に係わる配管洗浄装置は、配管洗浄装置の周囲温度に応じて冷媒の物理状態の制御目標値を決めるものである。

【００３２】本発明の請求項１５に係わる配管洗浄装置は、圧縮機を有する熱源機と被洗浄配管の間に接続される配管洗浄装置において、前記熱源機または前記配管洗浄装置の少なくともどちらか一方に前記圧縮機から吐出された冷媒を凝縮させる熱交換器を備えると共に、前記配管洗浄装置に、前記熱交換器により凝縮された冷媒を減圧させる膨張装置と、前記被洗浄配管を流通した冷媒から被洗浄物を分離回収する被洗浄物回収手段と、前記熱源機が有する熱源側制御装置から運転情報を伝送可能とする洗浄側制御装置とを備えたものである。

【００３３】本発明の請求項１６に係わる配管洗浄装置は、洗浄側制御装置が熱源機の運転状態に応じて熱交換器の熱交換量または膨張装置の絞り量または圧縮機の運転容量のうち少なくともいずれか１つを制御するものである。

【００３４】本発明の請求項１７に係わる配管洗浄装置は、圧縮機と外部に配設した運転制御装置に運転情報を伝送可能とする熱源側制御装置を有する熱源機と被洗浄配管の間に接続される配管洗浄装置において、前記熱源機または前記配管洗浄装置の少なくともどちらか一方に前記圧縮機から吐出された冷媒を凝縮させる熱交換器を備えると共に、前記配管洗浄装置において前記熱交換器により凝縮された冷媒を減圧させる膨張装置と、前記被洗浄配管を流通した冷媒から被洗浄物を分離回収する被洗浄物回収手段と、前記熱源側制御装置または／および前記運転制御装置の間で運転情報を伝送可能な洗浄側制御装置を備えたものである。

【００３５】本発明の請求項１８に係わる配管洗浄装置は、運転制御装置が、熱源機および配管洗浄装置の運転状態に応じて熱交換器の熱交換量または膨張装置の絞り量または圧縮機の運転容量のうち少なくともいずれか１つを制御するものである。

【００３６】本発明の請求項１９に係わる配管洗浄装置は、熱源機が有した熱源側制御装置と配管洗浄装置が有した洗浄側制御装置の間、あるいは外部に配設した運転制御装置と前記熱源側制御装置と前記洗浄側制御装置との間における運転情報の伝送に不具合が発生したときに、前記熱源機に配設された圧縮機の運転を停止する機能を熱源側制御装置に備えたものである。

【００３７】本発明の請求項２０に係わる配管洗浄装置は、熱源側制御装置、洗浄側制御装置または運転制御装置の少なくともいずれか１つに配管洗浄運転の進行状況を記録する記憶手段もしくは表示する表示手段を備えたものである。

【００３８】本発明の請求項２１に係わる配管洗浄装置は、熱源側制御装置、洗浄側制御装置または運転制御装置の少なくともいずれか１つに有した記憶手段に配管洗浄運転の完了もしくは未完了を記録するものである。

【００３９】本発明の請求項２２に係わる配管洗浄装置は、配管洗浄運転が未完了で中断した場合に、配管洗浄運転の進行状況の記録をもとに配管洗浄運転を再開する機能を洗浄側制御装置または運転制御装置の少なくともどちらか一方に備えたものである。

【００４０】本発明の請求項２３に係わる配管洗浄装置は、熱源側制御装置に配管洗浄運転の完了記録がなされていない場合、熱源機において配管洗浄運転以外の運転を禁止するものである。

【００４１】本発明の請求項２４に係わる配管洗浄方法は、既設使用の冷凍空調装置を既設配管から取り除くス

テップと、前記既設配管に配管洗浄装置を取り付けるステップと、前記配管洗浄装置により配管洗浄運転を行なうステップと、前記配管洗浄装置に設けた制御装置から遠隔設置された集中管理装置へ伝送される前記配管洗浄装置の運転状態の情報をもとに前記配管洗浄運転の適性を判断するステップとを備えたものである。

【００４２】本発明の請求項２５に係わる配管洗浄方法は、配管洗浄運転の適性判定により、運転制御条件または冷媒量調整の変更を行なうステップを備えたものである。

【００４３】

【発明の実施の形態】実施の形態１．以下本発明の実施の形態１を図に基づいて説明する。図１は実施の形態１による配管洗浄装置の冷媒回路図である。図において、１は圧縮機、２は油分離器、３は凝縮器、４、６は冷凍空調装置の熱源機と室内機を接続する既設配管であり、被洗浄配管、５は既設配管４、６の一端を接続するバイパス管、７は電子膨張弁、８は蒸発器、９は被洗浄物の分離回収装置、１０はアキュムレータである。１１は配管洗浄装置であり、配管洗浄装置１１は圧縮機１、油分離器２、凝縮器３、電子膨張弁７、蒸発器８、分離回収装置９、アキュムレータ１０を順次接続して構成され、既設配管４、６のバイパス管５が接続されなかったもう一端に接続弁１２ａ、１２ｂを介して接続される。圧縮機１は回転数可変の圧縮機となっており、回転数を変化させることで搬送する冷媒流量を増減でき、凝縮器３、蒸発器８はファン（図示せず）によって送風される配管洗浄装置１１周囲の外気と熱交換を行う。また１３ａは圧縮機１の吐出温度を計測する温度センサ、１３ｂは凝縮器３の出口、被洗浄配管４の入口の温度を計測する温度センサ、１３ｃは圧縮機１の吸入温度を計測する温度センサ、１４ａは配管洗浄装置の高圧圧力を計測する圧力センサ、１４ｂは配管洗浄装置の低圧圧力を計測する圧力センサである。１５は、温度センサ１３ａ、１３ｂ、１３ｃ、圧力センサ１４ａ、１４ｂの計測値から圧縮機１の回転数、凝縮器３、蒸発器８のファン風量、電子膨張弁７の開度を制御する計測制御装置である。

【００４４】この発明では、図１に示すように冷凍サイクルが構成されており、冷凍サイクルを循環する冷媒としてＨＦＣ系混合冷媒であるＲ４０７Ｃが用いられる。Ｒ４０７Ｃは、Ｒ３２／Ｒ１２５／Ｒ１３４ａが２３／２５／５２ｗｔ％の割合で混合した非共沸混合冷媒であり、冷凍機油としてはこの冷媒と相溶性を有するエステル油が使用される。また既設配管４、６はＨＣＦＣ系冷媒を用いた冷凍空調装置が過去に接続されており、この既設配管にはＨＣＦＣ系冷媒用の冷凍機油である鉱油が残存している。Ｒ４０７Ｃに対する鉱油の溶解度は１％以下であり、鉱油とはほとんど溶解性がない。

【００４５】次に本発明の洗浄手順について説明する。既設配管４、６に接続されている交換の必要な熱源機、室内機を取り外し、図１のように既設配管４、６に配管洗浄装置１１、およびバイパス管５を接続する。接続後冷凍サイクル全体を真空引きした後、Ｒ４０７Ｃを適量充填する。その後圧縮機１を運転する。このときの冷凍サイクルの運転状況は以下のようになる。圧縮機１から吐出された高温高圧のガス冷媒はまず油分離器２を通過する。この段階でガス冷媒と一緒に圧縮機１から吐出された冷凍機油は油分離器２で分離され圧縮機１の吸入側に戻される。高温高圧のガス冷媒はその後凝縮器３によってガスが一部冷却され液となり、高圧の気液二相冷媒になる。この高圧の気液二相冷媒は既設配管４、バイパス管５、既設配管６を通過しこれらの配管内部の洗浄を行った後、電子膨張弁７によって低圧の気液二相冷媒に減圧される。この後蒸発器８で加熱され低圧のガスになる。次に分離回収装置９を通過し、この際、既設配管４、６内で洗浄され配管内付着から引き剥がされた鉱油が冷媒から分離され、鉱油は分離回収装置９に保持される。低圧の冷媒ガスはこの後アキュムレータ１０を経て圧縮機１に吸入される。

【００４６】このように配管洗浄装置による冷凍サイクルを運転させることで被洗浄配管である既設配管に気液二相混合流、すなわちガスと液の混合された冷媒を流すことが可能となる。ここで、既設配管に気液二相冷媒を流して洗浄を行う理由について説明する。図２は本発明に関して、洗浄する際の冷媒の状態毎に鉱油の配管残存量と洗浄時間による洗浄特性を示した図であり、横軸は洗浄時間、縦軸は洗浄後配管に残留する鉱油量を表している。図２に示すように鉱油の洗浄を行う場合、ガス単相、液単相、気液二相（ガス液混合）の３つの状態のなかでは図中の◇印による一点鎖線で表わす気液二相で洗浄を行ったときの洗浄特性が優れていることがわかる。

【００４７】従来の洗浄ではＨＣＦＣ２２５などの洗浄液を液単相として配管に流し、洗浄液が配管に付着した鉱油を溶解することで洗浄を行っていた。また、Ｒ４０７Ｃを流して洗浄を行った場合、従来と同様に配管に液として流して洗浄を行うと、この冷媒と鉱油とは溶解性がほとんどないので、鉱油をＲ４０７Ｃとのせん断力で引っ張って移動させて洗浄することになる。この場合、鉱油の移動速度は冷媒液の流速に比べて著しく遅く、洗浄を行うのに時間がかかり実用的でない。また配管にＲ４０７Ｃをガスとして流す方法もあるが、この場合も同様に鉱油をＲ４０７Ｃとのせん断力で引っ張って移動させて洗浄することになり、鉱油の移動速度が遅く洗浄を行うのに時間がかかり実用的でない。

【００４８】一方、気液二相混合流で洗浄する場合、二相流は気液が混合して流れるため流れの乱れ具合が液単相、ガス単相を流す場合よりも大きくなる。そのため気液二相冷媒中の液冷媒の乱れが配管壁面付近で大きくなり、壁面に付着している鉱油を壁面から引き剥がす作用を行う。壁面から引き剥がされた鉱油は冷媒中を移動す

るので、移動速度は冷媒と同じとなる。従ってＲ４０７Ｃとのせん断力で引っ張って移動させて洗浄することに比べ高速で冷媒を移動させることが可能となり、鉱油の洗浄が速やかに短時間で行われる。

【００４９】このように気液二相冷媒による鉱油除去の洗浄特性は、鉱油をせん断力で移動させる能力および配管から鉱油を引き剥がす能力に依存するが、これらの能力は冷媒の流速、すなわち流量が大きくなるほど大きくなるので、配管洗浄においては、冷媒流量が大きいほど洗浄能力が向上する。従って冷媒流量が増加すると短時間で洗浄が可能になったり、同一洗浄時間であってもより十分な洗浄が可能となる。

【００５０】配管の洗浄終了後は、圧縮機１の運転を停止し、接続弁１２ａを閉じる。その後再度圧縮機１の運転を行うと、接続弁１２ａが閉じられているので、圧縮機１から吐出された冷媒は凝縮器３に追い込まれて蓄積され、一方既設配管４、６やバイパス管５内の冷媒はアキュムレータ１０へ引き出され、所謂ポンプダウン運転を行うことで、既設配管４、６中に残存するＲ４０７Ｃを回収する。Ｒ４０７Ｃの沸点は－４３℃と低いため、このポンプダウン運転を行うことで容易に蒸発ガス化するため、洗浄液としてのＲ４０７Ｃの回収も容易に行うことができる。ポンプダウン運転終了後は接続弁１２ｂを閉じ、Ｒ４０７Ｃの回収を終了する。

【００５１】Ｒ４０７Ｃ回収後は既設配管から配管洗浄装置１１、バイパス管５を取り外し、新規に交換後設置される熱源機、室内機を取り付け、既設配管の洗浄および冷凍空調装置の交換を完了する。このように行うことで、配管の再設置を行うことなく簡単に冷凍空調装置の入れ替えが可能となる。

【００５２】次に、洗浄運転中の配管洗浄装置１１の運転方法について説明する。前述したとおり、洗浄能力を向上させ、洗浄時間の短時間化や、より十分な洗浄を実現するためには、冷媒による洗浄流量が大きくなる運転を実施する必要がある。そこで圧縮機１の運転特性に着目すると、図３に示されるように圧縮機１の回転数が大きいほど、また圧縮機１の吸入圧力、すなわち低圧が高いほど搬送される冷媒流量は増加する。そこで、洗浄運転においては圧縮機１の回転数は運転に支障のない範囲でできるだけ高い回転数で運転する。このように運転することで、搬送される冷媒流量は増加し、洗浄能力を向上できる。ただし、圧縮機吐出側の高圧が圧縮機１など配管洗浄装置１１の許容設計圧力を越える恐れがある場合や、過負荷運転を行なって、圧縮機１の運転負荷が許容値を超える恐れがある場合などには、回転数を適宜低下させて運転し、圧縮機１運転の信頼性を確保する。

【００５３】なお、圧縮機の回転数を可変させる方法以外の方法、例えば気筒数（シリンダー数）を変化させることで運転容量を変化させるような場合であっても同様に、洗浄運転中はできるだけ多くの冷媒流量が流れるように圧縮機の運転容量を大きく制御し、高圧が圧縮機１など配管洗浄装置１１の許容設計圧力を越える恐れがある場合や、過負荷運転となり、圧縮機１の運転負荷が許容値を超える恐れがある場合などには、運転容量を適宜低下させて運転し、圧縮機１運転の信頼性を確保する。

【００５４】また、洗浄流量を大きくするためには圧縮機の吸入圧力である冷凍サイクルの低圧側圧力を高くなるように制御することでも対応できる。例えば、目標洗浄時間内に洗浄完了できる洗浄流量を予め定めておき、圧縮機１の回転数が決定されている場合には、図３の相関から洗浄に必要な流量を確保するための低圧圧力の目標値を決定することができる。この低圧を実現できるよう配管洗浄装置１１の各機器の制御を実施する。例えば洗浄運転中の現在の低圧圧力が目標値より低い場合には、電子膨張弁７の開度を大きくしたり、蒸発器８のファン風量を増加させることで低圧を上昇させる。また凝縮器３のファン風量を減少させても低圧を上昇させることができる。この場合、ファン風量の減少により高圧が上昇し、その上昇に伴って低圧が上昇する。

【００５５】なお低圧圧力の目標値を定めているが、運転中に低圧の値がこの値以上になってもよい。この場合は、圧縮機１で搬送される冷媒流量がより増加するので、洗浄能力がさらに向上し、同一洗浄時間であってもより十分な洗浄が可能となる。ただし、低圧をあまりにも高く運転すると、圧縮機１で搬送される冷媒流量が大きくなりすぎ、圧縮機１が過負荷運転となり運転負荷が許容値を超える恐れがある場合も発生する。このような場合は低圧圧力の上限を定めておき、この低圧圧力以上となる運転を実施しないように、凝縮器３のファン風量を増加、蒸発器８のファン風量を減少、電子膨張弁７の開度を小さく制御する。

【００５６】また、洗浄運転中の配管洗浄装置１１の運転方法として、予め高圧圧力の目標値を定めておき、この目標値になるように配管洗浄装置１１を運転してもよい。高圧が高いと、洗浄する二相冷媒の温度も上昇し、それに伴い被洗浄油の温度も上昇する。油など液体の粘性は高温になるほど低下するので、せん断力で鉱油を移動させる際には、鉱油が移動しやすくなり洗浄能力が向上する。そこで必要な洗浄能力が得られる温度を予め定めておき、その温度を実現できる圧力を高圧圧力の目標値とする。この温度については洗浄能力を考えると３０℃以上に設定されることが望ましい。この高圧圧力の目標値となるよう配管洗浄装置１１を運転する。例えば洗浄運転中の現在の高圧が目標値より低い場合には、凝縮器３のファン風量を減少させることで高圧を上昇させる。また電子膨張弁７の開度を大きくしたり、蒸発器８のファン風量を増加させてもよい。こうすることで、低圧が上昇し、その上昇に伴って高圧を上昇させることができる。

【００５７】なお高圧圧力の目標値を定めているが、運

転中に高圧の圧力値がこの値以上になってもよい。この場合は、油の粘性がさらに低下するので、さらなる洗浄能力の向上が実現できる。ただし、高圧をあまりにも高く運転すると、圧縮機１など配管洗浄装置１１の許容設計圧力を越える恐れがある場合も発生する。このような場合は高圧圧力の上限を定めておき、この高圧以上となる運転を実施しないように、凝縮器３、蒸発器８のファン風量、電子膨張弁７の開度を制御する。

【００５８】また、被洗浄配管４、６の配管長が長い場合には、配管の圧力損失が大きくなるため、高圧をある程度高くしないと、配管の圧力損失によって低圧が低下してしまい、圧縮機１で搬送される冷媒流量が洗浄に必要な流量より低下してしまう場合が発生する。このような状況に対応するためにも、低圧が必要以上に低下しないように高圧をある値以上高くなるように運転する。この場合の高圧を高くする制御方法は前述した方法と同じ方法で実施できる。

【００５９】また、洗浄運転中の配管洗浄装置１１の運転方法として、予め圧縮機１の吐出温度の上限を定めておいてもよい。前述したように高圧を上昇させる運転を行った場合、それにともなって吐出温度も上昇しやすくなる。このとき、吐出温度が圧縮機１内の油の劣化を引き起こす温度まで上昇すると、圧縮機１の運転信頼性を低下させるので好ましくない。このような状態を避けるため、運転中の吐出温度が吐出温度の上限を越える恐れがある場合には、吐出温度を低下させる運転を行う。吐出温度を低下させるためには、高圧を低下させるかあるいは圧縮機１の吸入温度を低下させることが有効となるので、凝縮器３のファン風量を増加させて高圧を低下させたり、蒸発器８のファン風量を低下させるあるいは電子膨張弁７の開度を大きくすることで、蒸発器８出口の冷媒過熱度、および吸入温度を低下させたりすることで吐出温度を低下させる。

【００６０】また、洗浄運転中の配管洗浄装置１１の運転方法として、圧縮機１の吸入側の冷媒過熱度がとる範囲を定めておいてもよい。前述したような冷凍サイクルの低圧、高圧を上昇させる制御を行った場合、各機器の制御によっては、圧縮機１吸入の冷媒が過熱ガス状態とならず、圧縮機に液が戻ったり、あるいは圧縮機１吸入の冷媒過熱度が大きくなりすぎ、吸入温度が上昇し、それにより吐出温度上昇を引き起こしたりする場合が発生する。圧縮機１への液戻りや吐出温度の上昇は、圧縮機１運転の信頼性を低下させるので、圧縮機１の運転における信頼性を確保するためには、圧縮機１吸入の冷媒過熱度がとる適切な範囲、例えば過熱度５℃～１０℃の範囲とし、この範囲内に冷媒過熱度を制御する。冷媒過熱度の制御は直接的には、電子膨張弁７の開度の大小で制御できるが、凝縮器３、蒸発器８のファン風量の制御により間接的に行っても良い。すなわち、冷媒過熱度が高い場合には電子膨張弁７の開度を大きくすることで過熱度を低くするが、他の方法として蒸発器８のファン風量を低下させることで、蒸発器８での熱交換量を低減させ、過熱度を低くしてもよいし、凝縮器３のファン風量を低下させ、高圧を高くし、それに付随して低圧も高くし、外気と蒸発器８での冷媒温度を近接させ蒸発器８での熱交換量を低減させ、過熱度を低くしてもよい。また、逆に冷媒過熱度が低い場合にはこれらの操作と反対の操作を行うことで、過熱度を高く制御する。

【００６１】また、さらに洗浄運転中の配管洗浄装置１１の運転方法として、被洗浄配管４に流入する冷媒状態を気液二相冷媒として、この気液二相冷媒の乾き度を所定の範囲内になるように制御してもよい。被洗浄配管４に流入する冷媒状態を気液二相冷媒とした場合、洗浄能力が向上することは前述の説明の通りである。また気液二相冷媒であっても、その乾き度が１に近い場合には、ガスの流れの中を液滴が噴霧状に流れている噴霧流となり、ほぼガス単相と同一の流れとなり、乾き度が０に近い場合には、液の流れの中を気泡が流れている気泡流となり、ほぼ液単相と同一の流れとなり、気液二相流とすることによる洗浄能力の向上効果が得にくい場合も存在する。従って同じ気液二相冷媒であっても、洗浄能力を考えると、乾き度１，乾き度０近辺ではない気液二相流、即ち乾き度が０．２～０．９程度の乾き度に設定することが望ましい。このように被洗浄配管４に流入する冷媒状態を気液二相冷媒として、さらにこの二相冷媒の乾き度を所定の範囲内になるように制御するために以下のような制御を実施する。

【００６２】まず、気液二相冷媒の乾き度の検知方法であるが、高圧圧力、および凝縮器３の出口温度を計測する。洗浄冷媒としてＲ４０７Ｃを用いた場合、その非共沸性により、圧力、温度、乾き度の相関には図４に示すような相関がある。図４は圧力一定の場合における冷媒の乾き度と温度との関係を示す図で、横軸は冷媒の乾き度、縦軸は冷媒の温度を示す。図４からは乾き度が増加するに比例して冷媒の温度も増加することがわかる。従って圧力、温度を検知することにより、乾き度を求めることができる。この乾き度が目標とする乾き度より低い、例えば０．２より低い場合の制御方法であるが、この場合は凝縮器３での凝縮量が大きすぎるため、凝縮器３のファン風量を低下させて、凝縮量を低減することで、乾き度を高めに制御する。また電子膨張弁７の開度を大きくしても、蒸発器８のファン風量を低下させてもよい。こうすることで、蒸発器８での過熱度が減少し、蒸発器８内のガス冷媒が存在する領域が減少し、その分液冷媒が存在する領域が増加する。そこで蒸発器８内に存在する冷媒量が増加するため、この増加分の冷媒が凝縮器３から蒸発器８に移動する。従って凝縮器３での冷媒量が減少し、結果凝縮器３出口での冷媒乾き度が高い方向に制御される。乾き度が目標とする乾き度より高い場合は、これらの操作の反対の操作を行うことで、乾き

度を低く制御する。

【００６３】以上で述べた凝縮器３、蒸発器８の熱交換量の制御方法はファン風量の増減によって行っているが、この際ファン風量を減少させる一つの方法として、ファンそのものを停止させてもよい。またファン風量の増減で凝縮器３、蒸発器８での熱交換量を増減させる代わりに、図５に示すように凝縮器３あるいは蒸発器８の構成を複数に分割された熱交換器に分岐する構成として、分岐された一部を電磁弁などの弁１６によって、閉止、あるいは流れる流量を増減することで、熱交換量を変化させてもよい。この場合、弁１６の開度を閉方向に制御することで分岐の一部を閉止、あるいは流量を低減させ熱交換量を低減し、逆に弁１６の開度を開方向に制御することで閉止させる分岐部を減少、あるいは無くす、あるいは分岐部の流量を低減しないようにし熱交換量を増加させることもできる。

【００６４】また、図６に示すように凝縮器３あるいは蒸発器８の構成として、これらの熱交換器をバイパスするバイパス配管１７を設けてもよい。このバイパス配管１７にも閉止、あるいは流量を調節できる電磁弁などの弁１６を設け、熱交換量を減少させたいときは、弁１６の開度を開方向に制御することでバイパス配管１７に流れる流量を増加させ、熱交換量を増加させるときは弁１６の開度を閉方向に制御することでバイパス配管１７に流れる流量を減少、あるいはバイパス配管１７を閉止する。このような制御を行うことでファン風量の増減させる場合と同様に凝縮器３、蒸発器８の熱交換量の制御を行うことが可能となる。

【００６５】また配管洗浄装置１１周囲の外気温度が低い場合には、ファンを停止させても凝縮器３での外気への放熱による熱交換量が大きくなりすぎ、熱交換量を低減させる制御が十分に実施できない場合も発生する。この場合は凝縮器３、あるいは配管洗浄装置１１全体を外気と断絶する覆いなどを設けてもよい。図７は配管洗浄装置における凝縮器の構成を示す図、図８、図９および図１０は配管洗浄装置における覆いの設置方法を示す図である。例えば図７のように凝縮器３が配管洗浄装置１１内に設置され、外気が装置外郭側面の外気吸込口１８から流入し、そして外郭上面の外気吹出口１９へ図に示すように通風される構成となっている場合、図８に示すように外気吸込口１８、および外気吹出口１９に外気と遮断する覆い２０を設ける。あるいは図９に示すように配管洗浄装置１１全体に覆い２０を設ける。こうすることで、外気温度が低い場合での凝縮器３での放熱量を低減でき、凝縮器３での熱交換量を適切に制御することが可能となる。なお、これらの覆い２０には、ファンを動作させたときに外気の風路を確保するために、図１０のように覆いの一部に外気が通過する風路２１を設けてもよい。このように外気が通過する風路２１を設けることで、覆い２０を設置しても、ファン風量の増減による熱交換量の制御が実施可能となる。なお覆い２０の設置場所としては、図８、図９に図示されている部分の全てでなく一部に設置されてあっても同様の効果を得ることができる。

【００６６】また配管洗浄装置１１周囲の外気温度が低い場合に、ファンを停止させても凝縮器３での熱交換量が大きくなりすぎる場合の他の対策として、凝縮器３の冷媒回路上流側、あるいは下流側、あるいは吸込外気を加熱するヒータなどの加熱装置を設置してもよい。放熱量が大きくなりすぎる場合は、加熱装置で、冷媒あるいは吸込外気を加熱することで、冷媒に作用する放熱量の影響を低減することが可能となり、凝縮器３での熱交換量を適切に制御することが可能となる。なお、凝縮器３あるいは蒸発器８の構成として、外気と熱交換する構成としているが、水熱交など他の媒体で熱交換する形式であってもよい。この場合、水量など熱交換器に供給される媒体の量を制御することで、ファン風量を制御する場合と同様の制御を行うことができる。

【００６７】また被洗浄配管４、６が長い場合には、配管での圧力損失が大きくなるため、低圧圧力が低下しないよう電子膨張弁７の開度を大きく制御する方法を述べたが、電子膨張弁７の構成によっては、開度を最大開度に設定しても、電子膨張弁７である程度の圧力差を生じてしまい、低圧圧力の低下を防止できない場合も発生する。このような場合は図１１に示すように、電子膨張弁７に並列にバイパス配管１７、およびバイパス配管１７上に電磁弁などの弁１６を設け、電子膨張弁７での圧力差を低減させたい場合には、弁１６を開き、バイパス配管１７に冷媒が流れるようにすることで、電子膨張弁７での圧力差を低減してもよい。こうすることで、被洗浄配管４、６が長く配管での圧力損失が大きい場合でも、低圧圧力の低下を防止でき、洗浄に必要な冷媒流量を確保することができる。

【００６８】ここまで述べた制御方法では、圧縮機１、凝縮器３、蒸発器８のファン風量、電子膨張弁７の開度を制御することで配管洗浄装置１１の高圧圧力、低圧圧力、吐出温度、圧縮機吸入の過熱度、被洗浄配管４に流入する冷媒の乾き度を制御させる方法について説明したが、配管洗浄装置１１に充填される冷媒量を調節することで、これらの状態量の制御を行ってもよい。冷媒充填量を増加させると、配管洗浄装置１１運転時の高圧は高く、低圧は高く、吐出温度は低く、圧縮機吸入の過熱度は低く、被洗浄配管４に流入する冷媒の乾き度は低く変化するので、予め設定される高圧、低圧、吐出温度、圧縮機吸入の過熱度、被洗浄配管４に流入する冷媒の乾き度の目標値を実現できるように、充填冷媒量を調節する。この充填量については、被洗浄配管４、６の設置状態や外気温度などの情報から予め決められている算出式によって求められた冷媒量を充填してもよいし、洗浄運転途中の運転状態と各目標値との偏差から、充填される

冷媒量を増減させてもよい。

【００６９】また被洗浄配管４、６での流動抵抗が大きい場合、例えば被洗浄配管４、６が長い場合や配管径が小さい場合などは、配管洗浄装置１１の洗浄運転での制御目標値をその被洗浄配管の流動抵抗に応じて変化させてもよい。例えば、被洗浄配管４、６での流動抵抗が大きく、低圧圧力が上昇せず、洗浄に必要な流量を確保できない場合には、高圧圧力の目標値を高く修正することで、低圧を上昇させ、洗浄に必要な冷媒流量を確保させる。あるいは、被洗浄配管４、６での流動抵抗は、気液二相流が流れる場合、ガスの割合が多くなる、すなわち高乾き度になるほど増加するので流動抵抗を低減させるために、被洗浄配管４、６に流入する冷媒の乾き度の目標値を低く修正する。このすることで被洗浄配管４、６での流動抵抗を小さくし低圧を上昇させ、洗浄に必要な流量を確保させる。なお、被洗浄配管４、６での流動抵抗については、被洗浄配管４、６の形態についての情報を洗浄運転前に予め、計測制御装置１５にインプットしておき、そのインプット値から流動抵抗を判断して、運転の目標値を変更してもよいし、洗浄運転を実施中に運転状態から、低圧が引きあがらない場合などは流動抵抗が大きいと判断して、運転の目標値を変更してもよい。

【００７０】以上の配管洗浄装置１１の運転では、被洗浄配管４、６の一端に取り付けられていた室内機を取り外して洗浄を行った場合について説明したが、図１２に示すように室内機２２を取り付けたまま洗浄を行っても、同様の運転制御を行うことで、洗浄能力を向上させた運転を実施できる。図１２は配管洗浄装置の他の形態を示す冷媒回路図であり、図において２２は室内機、２３は利用側熱交換器、２４は電子膨張弁、そして図１と同一部分には同符号を付し、その説明は省略する。この室内機２２については、配管洗浄前から接続されていた室内機２２を被洗浄配管４、６と同時に洗浄を行い、熱源機の交換後も継続して用いるとしてもよいし、熱源機の交換と同時に新設の室内機２２に交換し、この新設室内機２２を接続したまま洗浄運転を行ってもよい。

【００７１】以上に示したように、配管洗浄装置１１の運転制御において、洗浄に必要な冷媒流量を確保し、被洗浄配管４に流入する冷媒の温度を高くし、被洗浄配管４に流入する冷媒状態をある定められた範囲内の乾き度の気液二相流とすることで、洗浄能力を向上させた運転を実現するとともに、高圧、圧縮機１の吐出温度、圧縮機１の吸入乾き度を配管洗浄装置１１の運転に問題を生じさせないように制御することで、配管洗浄装置１１の運転の信頼性を高めることが可能となる。

【００７２】配管を洗浄する洗浄冷媒としてはＲ４０７Ｃに限るものではなく、他のＨＦＣ系の単一冷媒や混合冷媒でもよく、例えばＲ３２（微燃性・無毒）、Ｒ１２５（不燃性・無毒）、Ｒ１３４ａ（不燃性・無毒）、Ｒ４１０Ａ（不燃性・無毒）、Ｒ４０４Ａ（不燃性・無毒）で洗浄を行ってもよい。またプロパンやブタンやイソブタンなどのＨＣ系冷媒およびその混合冷媒、アンモニア、炭酸ガスなどの自然冷媒を用いてもよい。

【００７３】実施の形態２．以下本発明の実施の形態２を図に基づいて説明する。図１３は実施の形態２における配管洗浄装置の冷媒回路図である。図において、２５は高低圧熱交換器であり、その他の実施の形態１の図１と同一部分には同符合を付し、説明を省略する。高低圧熱交換器２５においては凝縮器３で一部冷却された高圧の冷媒と、電子膨張弁７から流出した低圧の冷媒との間で熱交換を行う。図１４はこの高低圧熱交換器２５の回路構成図であり、図において、２６は二重管になっており、外側の管に高圧冷媒が流れ、内側の管に低圧冷媒が対向した向きに流れる構成となっている。１７は低圧側冷媒流におけるバイパス配管、１６はバイパス配管１７を流れる冷媒流量を調節する電磁弁などの弁であり、弁１６の開閉によってバイパス配管１７を通過する冷媒流量を調節することで、高低圧熱交換器２５での熱交換量を制御できるようになっている。

【００７４】この配管洗浄装置の運転状況を図１５のＰＨ線図に基づいて説明する。図において、横軸にエンタルピーH、縦軸に圧力を示す。図１３で示す圧縮機１から吐出された高温高圧のガス冷媒（Ａ）はまず油分離器２を通過する。この段階でガス冷媒と一緒に圧縮機１から吐出された冷凍機油は油分離器２で分離され圧縮機１吸入側に戻される。高温高圧のガス冷媒はその後凝縮器３によって圧縮機の入力分冷却され温度が低下したガスとなる（Ｂ）。その後この高圧のガス冷媒はさらに高低圧熱交換器２５によって一部冷却された後（Ｃ）、既設配管４、バイパス管５、既設配管６を通過した後、電子膨張弁７によって低圧の気液二相冷媒に減圧される（Ｄ）。この後高低圧熱交換器２５で加熱され低圧のガスになる（Ｅ）。このとき、高圧側の熱交換量と低圧側の熱交換量は同じになるので、ＢＣ間のエンタルピ差とＤＥ間のエンタルピ差は同じ値になる。次に分離回収装置９を通過し、この際、既設配管４、６内で洗浄された鉱油が分離され、鉱油は分離回収装置９に保持される。低圧の冷媒ガスはこの後アキュムレータ１０を経て圧縮機１に吸入される。このように蒸発器８に代えて高低圧熱交換器２５を設けた場合、前述の実施の形態１で示すように蒸発器８では外気との熱交換が必要であったため、空気側の伝熱効率が悪く、蒸発器８の熱交換器サイズが大きくなったが、高低圧熱交換器２５の場合、熱交換が冷媒と冷媒の間で行われるので、伝熱効率がよく、高低圧熱交換器２５のサイズが小さくなり、配管洗浄装置１１をコンパクトに作成することが可能となる。

【００７５】次に配管洗浄装置１１の運転制御について説明する。圧縮機１、凝縮器３のファン風量、電子膨張弁７の開度の制御、および冷媒充填量の調整により配管洗浄装置１１の高圧圧力、低圧圧力、吐出温度、圧縮機

吸入側の過熱度、被洗浄配管４に流入する冷媒の乾き度を制御させる方法について実施の形態１と同じになるので説明を省略する。次に高低圧熱交換器２５の熱交換量の制御方法であるが、高低圧熱交換器２５の熱交換量を大きくすると、高圧冷媒を凝縮させる熱交換能力と低圧冷媒を蒸発させる熱交換能力がともに増大する。ここで図１６は配管洗浄装置の高低圧熱交換器の熱交換量変化時の運転状況を示すＰＨ図であり、横軸にエンタルピーＨ、縦軸に圧力Ｐを示し、実線が熱交換量大、点線が熱交換量小である。従って図１６の実線で示すように、配管洗浄装置１１の運転状態としては、高圧側が低下、低圧側が上昇し、凝縮器となる高低圧熱交換器２５の高圧側出口の冷媒乾き度、すなわち被洗浄配管４に流入する冷媒乾き度が低くなり、低圧側出口の冷媒過熱度が高くなる。高低圧熱交換器２５の低圧側出口の冷媒過熱度が高くなることに伴い、圧縮機１の吸入過熱度も高くなり、それにより圧縮機１の吐出温度が高くなる。

【００７６】圧縮機の吐出温度、圧縮機１吸入の過熱度、被洗浄配管４に流入する冷媒の乾き度を目標値に制御させる場合には、この高低圧熱交換器２５の制御特性に従って、熱交換量の制御を実施する。一方、高圧、低圧の制御を実施する場合であるが、低圧が低く、洗浄に必要な冷媒流量が確保できていないため、低圧を引き上げ、冷媒流量を増加させたい場合には高低圧熱交換器２５の熱交換量を小さく制御する。このように制御を行うと、高圧が高く、低圧が低く制御される。このとき被洗浄配管４～電子膨張弁７の間の差圧が大きくなるので、被洗浄配管４～電子膨張弁７の流動抵抗が変わらない場合にはより多くの冷媒流量を流すことが可能となる。そこで圧力差の増加に見合った冷媒流量になるように低圧が上昇して圧縮機１で搬送される冷媒流量が増加される。従って高低圧熱交換器２５の熱交換量を小さく制御すると、結果的には高圧が高くなることに付随して低圧も高くなり、冷媒流量を増加させる運転が可能となる。また過負荷運転状態となって高低圧とも低くし冷媒流量を減少させたい運転したいような場合には、逆に高低圧熱交換器２５の熱交換量を大きく制御する。

【００７７】なお、高低圧熱交換器２５の熱交換量には最適範囲が存在する。冷媒流量を増加させるためには、前述したように熱交換量が小さいほど増加するが、あまりに小さくすると、圧縮機１吸入での冷媒過熱度が０となり、圧縮機１への液バックが発生して、圧縮機１の信頼性上好ましくない。またこのように圧縮機１に液冷媒が戻るような運転となった場合には、圧縮機１の吸入側にあるアキュムレータ１０内に液冷媒がたまり込む運転となる。このときには被洗浄配管４、６など他の冷凍サイクルに存在する冷媒量が減少するため、被洗浄配管４、６においては、気液二相流中のガス量が増加し、すなわち乾き度が増加し、結果被洗浄配管４、６での流動抵抗が増大する。被洗浄配管４、６の配管長が長く、もともと流動抵抗が大きい場合などにさらに流動抵抗増大するような運転を実施すると、低圧圧力が低下してしまい、その結果洗浄に必要な冷媒流量を確保できない運転となる。また高低圧熱交換器２５の熱交換量を大きくすると、冷媒流量が減少し、洗浄能力が低下するので好ましくないが、同時に熱交換量を大きくして吸入過熱度を増加させると、圧縮機１の吐出温度が高くなり、余りに高い温度になると、圧縮機の信頼性上好ましくない。

【００７８】以上から、高低圧熱交換器２５の熱交換量の設計容量としては、結果として生じる圧縮機１の吸入過熱度が所定の適切な範囲、例えば圧縮機１吸入の過熱度が０℃より大きく２０℃以下となる範囲に設定されることが望ましく、また高低圧熱交換器２５の熱交換量の制御を行う場合にも、同様に圧縮機１の吸入過熱度が所定の適切な範囲に制御されることが望ましい。

【００７９】なお、高低圧熱交換器２５の熱交換量については、外気温度に応じて変化させてもよい。配管洗浄装置１１の運転において外気温度が低い場合には、運転状況は図１７に示すようになる。図１７は外気温度４０℃、２０℃、－５℃における配管洗浄装置の運転状況を示した図であり、横軸にエンタルピーＨ、縦軸に圧力を示す。外気温度－５℃の場合（図中の実線）には被洗浄配管４、６および、配管洗浄装置１１からの放熱が大きくなるため被洗浄配管６の出口エンタルピ（Ｄ）および圧縮機１吸入のエンタルピ（Ｅ）が小さくなりやすい。その結果、圧縮機１吸入の過熱度が小さくなる運転となる。外気温度がさらに低い場合や、被洗浄配管４、６の配管長が長く、放熱量が大きくなりやすい場合には、圧縮機１吸入の過熱度がさらに小さくなり、圧縮機１への液バックが発生したり、アキュムレータ１０に冷媒が貯まり込み冷媒流量が低下するような運転となる。そこでこのような状況を回避するために、外気温度が低い場合には、予め高低圧熱交換器２５の熱交換量が大きくなるように制御する。このように制御を行うと圧縮機吸入の過熱度を適切に確保した運転が実現でき、圧縮機１の信頼性が確保できるとともに、洗浄に必要な冷媒流量を確保することが可能となる。

【００８０】一方、配管洗浄装置１１の運転において外気温度が高い場合の運転状況は、図１７の外気温度４０℃の場合（図中の一点鎖線）に示されるように、被洗浄配管４、６および、配管洗浄装置１１において外気からの吸熱量が大きくなるため、被洗浄配管６の出口エンタルピ（Ｄ）および圧縮機１吸入のエンタルピ（Ｅ）が大きくなりやすい。その結果、圧縮機１吸入の過熱度が大きくなる運転となる。この場合には、吐出温度が上昇し、外気温度が高く吐出温度が余りに高い温度になると、圧縮機１の信頼性上好ましくない。そこでこのような状況を回避するために、外気温度が高い場合には、予め高低圧熱交換器２５の熱交換量が小さくなるように制御する。このように制御を行うと圧縮機吸入の過熱度が

低くなる運転が実現でき、圧縮機の信頼性を確保できる。

【００８１】以上のように、高低圧熱交換器２５の熱交換量を適切に制御することで、圧縮機１運転の信頼性を確保するとともに、洗浄に必要な冷媒流量を確保した運転を実現することができる。

【００８２】なお、この実施の形態１においては、高低圧熱交換器２５を二重管で構成されるとして説明したが、プレート熱交換器など他の熱交換器形態をとっても同様の制御を実施することで、同じ効果を得ることができる。また熱交換量の制御方法としては、図１８に示す高低圧熱交換器の他の回路構成図のように、熱交換器を複数用意し、その一部に流れる冷媒流量を弁１６によって、減少あるいは流路を閉止することで熱交換量を制御してもよい。

【００８３】実施の形態３．以下本発明の実施の形態３を図に基づいて説明する。図１９は実施の形態３による配管洗浄装置の冷媒回路図である。図１９において、２７はガス冷却器であり、その他の実施の形態１、実施の形態２と同一部分には同符号を付し、その説明を省略する。ガス冷却器２７はファンによって送風される配管洗浄装置１１の周囲の外気と熱交換を行う。

【００８４】この配管洗浄装置１１の運転状況を図２０のＰＨ線図に基づいて説明する。図において、横軸はエンタルピーH、縦軸は圧力を示す。図１９に示す圧縮機１から吐出された高温高圧のガス冷媒（Ａ）はまず油分離器２を通過する。この段階でガス冷媒と一緒に圧縮機１から吐出された冷凍機油は油分離器２で分離され圧縮機１の吸入側に戻される。吐出された高温高圧のガス冷媒はその後高低圧熱交換器２５によって冷却され、気液二相冷媒となり（Ｂ）、既設配管４、バイパス管５、既設配管６を通過した後、減圧装置７によって低圧の気液二相冷媒に減圧される（Ｃ）。この後高低圧熱交換器２５で加熱され低圧のガスになる（Ｄ）。このとき、高低圧熱交換器２５に流入する高圧側の冷媒は圧縮機１の吐出状態であるためほとんどの運転条件で外気より高温となり、高低圧熱交換器２５の他方の冷媒と熱交換するので、低圧のガスの温度も外気より高い温度となる。このとき、高圧側の熱交換量と低圧側の熱交換量は同じになるので、ＡＢ間のエンタルピ差とＣＤ間のエンタルピ差は同じ値になる。そして、この後ガス冷媒はガス冷却器２７により、外気によって冷却される（Ｅ）。次に分離回収装置９を通過し、この際、既設配管４、６内で洗浄された鉱油が分離され、鉱油は分離回収装置９に保持される。低圧の冷媒ガスはこの後アキュムレータ１０を経て圧縮機１に吸入される。このように凝縮器３に代えて高低圧熱交換器２５を設けた場合、凝縮器３では外気との熱交換が必要であったため、空気側の伝熱効率が悪く、凝縮器３の熱交換器サイズが大きくなったが、高低圧熱交換器２５の場合、熱交換が冷媒と冷媒の間で行われるので、伝熱効率がよく、高低圧熱交換器２５のサイズが小さくなり、配管洗浄装置をコンパクトに作成することが可能となる。

【００８５】次に配管洗浄装置１１の運転制御について説明する。圧縮機１、高低圧熱交換器２５の熱交換量、電子膨張弁７の開度の制御、および冷媒充填量の調整により配管洗浄装置１１の高圧圧力、低圧圧力、吐出温度、圧縮機吸入の過熱度、被洗浄配管４に流入する冷媒の乾き度を制御させる方法について実施の形態１および実施の形態２と同じになるので説明を省略する。

【００８６】次に、ガス冷却器２７の制御方法であるが、ガス冷却器２７の制御を行うと以下のような運転状況となる。ガス冷却器２７のファン風量を増大させると、冷却量が増加するので、圧縮機の吸入過熱度が小さくなり、それに伴って吐出温度が低くなる。吐出温度が低下すると、高低圧熱交換器２５の入口ガス温度も低下する。ここで高低圧熱交換器２５内の高圧側の冷媒状態をみると、ガス冷媒から冷却され飽和ガス冷媒となりこの間ガスとして存在し、その後さらに冷却されガスが一部凝縮され気液二相冷媒となる。伝熱効率は、ガス単相であるよりも凝縮の生じる気液二相冷媒が３倍～５倍程度よくなるので、二相冷媒の存在する部分が多くなるほど、高低圧熱交換器２５の伝熱効率はよくなり熱交換量も増大する。高低圧熱交換器２５の入口ガス温度が低下すると、飽和ガス冷媒となりやすくなるので、高低圧熱交換器２５内に占めるガス部の割合が減少し、逆に気液二相部の割合が増加するので、熱交換量が増大する。従って、配管洗浄装置１１の運転状態は、実施の形態２で述べたように、高低圧とも低下し、冷媒流量の低下する運転となる。

【００８７】図２１は上述のガス冷却器２７のファン風量制御による運転状況の変化を表したＰＨ線図であり、図において、横軸はエンタルピーH、縦軸は圧力を示し、実線がガス冷却器ファン風量大の場合、点線がガス冷却器ファン風量小の場合を示す。図２１の実線で示すように、ガス冷却器２７のファン風量を増加させると、高低圧とも低下し、吐出温度、吸入温度が低下し、被洗浄配管４に流入する冷媒の乾き度が低くなる。このような制御特性に応じて、高圧圧力、低圧圧力、吐出温度、圧縮機１吸入の過熱度、被洗浄配管４に流入する冷媒の乾き度の目標値と、現在の値の偏差に基づいてガス冷却器のファン制御を実施し、高圧圧力、低圧圧力、吐出温度、圧縮機１吸入の過熱度、被洗浄配管４に流入する冷媒の乾き度の値が適切な値になるように制御する。

【００８８】このように配管洗浄装置１１の運転制御を行うことで、洗浄に必要な冷媒流量を確保し、洗浄能力を向上させるとともに、信頼性の高い配管洗浄装置の運転を実現できる。

【００８９】実施の形態４．図２２は本発明の実施の形態４を示す図で、配管洗浄装置の冷媒回路図である。図

において、２８は熱源機であり、冷媒回路は圧縮機１、油分離器２、四方弁２９、熱源側熱交換器３０、アキュムレータ１０で構成される。３１は鉱油回収装置であり、冷媒回路は高低圧熱交換器２５、電子膨張弁７、分離回収装置９、および逆止弁３２ａ、３２ｂ、３２ｃ、３２ｄで構成される。また１２ａ、１２ｂは鉱油回収装置３１と既設配管４、６を接続する接続弁、１２ｃ、１２ｄ、１２ｅ、１２ｆは熱源機２８と鉱油回収装置３１を接続する接続弁である。

【００９０】本実施の形態は図１３あるいは図１９に示す配管洗浄装置１１の代わりに、交換後設置される熱源機２８と鉱油回収装置３１を組み合わせて洗浄を行うものである。図２２で構成される冷凍サイクルは四方弁２９を実線方向に流すように設定した場合、図中の実線矢印方向に冷媒が流れ、回路構成は図１３と同じ構成となり、上述の実施の形態２と同様の効果を奏するものであり、洗浄も同様に行うことが可能となる。また四方弁２９を点線矢印方向に流すように設定した場合、ガス冷却器２７に相当する熱源側熱交換器３０と鉱油回収装置９の順序が入れ替わるものの図１９と同じ回路構成となり、上述の実施の形態３と同様の効果を奏するものであり、配管洗浄も同様に行うことが可能となる。洗浄完了後は鉱油回収装置３１、およびバイパス管５を取り外し、既設配管４、６に熱源機２８と室内機を接続することで、配管の洗浄および冷凍空調装置の交換を完了する。

【００９１】また図２２において、１５は熱源機２８の計測制御装置であり、３３は鉱油回収装置３１の計測制御装置である。配管洗浄運転の運転制御においてそれぞれの計測制御装置の働きは以下のように行う。まず、熱源機２８の計測制御装置１５では、圧縮機１の吐出温度、吸入温度、高圧圧力、低圧圧力を温度センサ１３ａ、１３ｃ、圧力センサ１４ａ、１４ｂによる測定値を得て、この情報を鉱油回収装置３１の計測制御装置３３に伝送する。鉱油回収装置３１の計測制御装置３３では、高低圧熱交換器の凝縮側出口側であり被洗浄配管入口に設けられた温度センサ１３ｂで測定される高低圧熱交換器２５出口の温度情報と熱源機２８から伝送される上記情報とを合わせて、圧縮機１の制御方法、熱源側熱交換器３０のファン風量、高低圧熱交換器２５の熱交換量、電子膨張弁７の開度を決定し、圧縮機１の運転回転数制御、熱源側熱交換器３０のファン（図示せず）の制御方法を、熱源機２８の計測制御装置１５に指示するとともに、高低圧熱交換器２５の熱交換量、電子膨張弁７の開度の制御を実施する。熱源機２８の計測制御装置１５ではこの鉱油回収装置３１からの情報を受け、圧縮機１の回転数、熱源側熱交換器３０のファンの回転数を制御実施する。一方、鉱油回収装置３１を取り外した後の通常の冷凍空調装置としての熱源機２８の運転制御は、計測制御装置１５で実施する。

【００９２】このように、配管洗浄運転中の運転制御は、鉱油回収装置３１の計測制御装置３３にまかせ、通常の冷凍空調装置としての熱源機２８の運転制御に熱源機２８の計測制御装置１５を特化させることで、図２２に構成されるような配管洗浄方法に元来対応していなかった熱源機であっても、大きな制御変更を伴うことなく配管洗浄運転を実施でき、配管洗浄運転を実施する場合の熱源機適用の幅を広げ、汎用性を高めることができる。

【００９３】また実施の形態４の別の形態として図２３に示す形態をとってもよい。図２３は配管洗浄装置の冷媒回路図を示す図であり、図において、３６は運転制御装置であり、図２２と同一または相当部分は同一符号を付ける。図２２とは、冷媒回路が同一であり、熱源機２８の計測制御装置１５と鉱油回収装置３１の計測制御装置３３の両方と情報伝送可能な外部に設けられ通信接続された運転制御装置３６を設けた点が異なるものである。運転制御装置３６はパソコンなど携帯できる移動端末であり、熱源機２８、鉱油回収装置３１の運転制御を実施できる機能と熱源機２８の計測制御装置１５および鉱油回収装置３１の計測制御装置３３と情報を伝送する機能を持つ。　配管洗浄運転中の運転制御は以下のように実施される。まず、熱源機２８に設けた熱源側計測制御装置１５では、前述したように各圧力センサ、温度センサから熱源機１５側の運転状態の測定値を得て、この情報を運転制御装置３６に伝送する。また鉱油回収装置３１に設けた洗浄側計測制御装置３３でも前述したように、温度センサ１３ｂで測定される高低圧熱交換器２５出口の温度測定値を得て、この情報を運転制御装置３６に伝送する。運転制御装置３６では、これらの運転情報を得て、圧縮機１などの熱源機２８内の各アクチュエータに対する制御内容、高低圧熱交換器２５などの鉱油回収装置３１内の各アクチュエータに対する制御内容を決定し、これらの決定された制御を実施するように計測制御装置１５、３３に指示する。

【００９４】なお、図２３では、運転制御装置３６と熱源機２８の熱源側計測制御装置１５、さらに運転制御装置３６と鉱油回収装置３１の洗浄側計測制御装置３３が直接接続されて運転制御装置３６を中心に情報伝送する形となっているが、各制御装置にネットワーク機能を持たせて、運転制御装置３６と熱源機２８の計測制御装置１５、運転制御装置３６と鉱油回収装置３１の洗浄側計測制御装置３３が間接的に接続されても、運転制御装置３６と熱源機２８の熱源側計測制御装置１５、運転制御装置３６と鉱油回収装置３１の洗浄側計測制御装置３３との間で情報伝送できる形態をとってもよい。たとえば、運転制御装置３６と熱源機２８の熱源側計測制御装置１５が接続され、この熱源側計測制御装置１５と鉱油回収装置３１の洗浄側計測制御装置３３が接続されていて、各制御装置がネットワーク機能を保持し、運転制御

装置３６と鉱油回収装置３１の洗浄側計測制御装置３３が情報伝送可能となっていれば、運転制御装置３６にて前述したような運転情報の取得および運転制御の指示を行うことができる。

【００９５】このような形態であっても、配管洗浄運転中の運転制御は、運転制御装置３６にまかせ、通常の冷凍空調装置としての熱源機２８が有する運転制御部分に上述の熱源機２８の熱源側計測制御装置１５を特化させることで、図２３に構成されるような配管洗浄方法に対して元来対応していないなかった熱源機であっても、それが有する制御装置に大きな制御変更を伴うことなく配管洗浄運転が実施でき、配管洗浄運転を実施する場合の熱源機適用の幅を広げ、汎用性を高めることができる。また、鉱油回収装置３１が様々な種類の熱源機に接続使用され、様々な熱源機２８に応じて配管洗浄運転の制御方法を変更しなければならない場合、このような形態をとると、運転制御装置３６が保持する熱源機２８、鉱油回収装置３１に対する制御内容を熱源機２８に応じて変更することで対応可能となる。例えば、運転制御装置３６がパソコンであった場合には、配管洗浄運転に際して実行される制御プログラムを適宜変更することで容易に運転制御を変更できる。従って、鉱油回収装置３１の洗浄側計測制御装置３３に配管洗浄中の運転制御方法を保持する必要がなくなり、各アクチュエータの駆動に特化することで、鉱油回収装置３１の洗浄側計測制御装置３３の運転制御方法を熱源機２８に応じて変更する必要がなくなり、鉱油回収装置３１を用いた場合の配管洗浄運転をより汎用性を持たせて実施することができる。

【００９６】なお、図２２、図２３に示すような形態で配管洗浄運転を実施した場合、熱源機２８の熱源側計測制御装置１５と鉱油回収装置３１の洗浄側計測制御装置３３、あるいはこれらと運転制御装置３６の間で情報の伝達が行われる。この情報の伝達がノイズなどの影響でうまくいかない場合、熱源機２８の運転情報の伝達を行えない、あるいは熱源機２８の圧縮機１などのアクチュエータの制御の指令がなされないことになる。これにより、熱源機２８の圧縮機１が異常運転を行い、圧力の過上昇などにより熱源機２８の破損を引き起こす可能性がある。そこで、情報の伝達など各計測制御装置および運転制御装置間の通信に異常が認められる場合には、熱源機２８の圧縮機１を速やかに停止し、熱源機２８を保護する。保護の方法としては、例えば熱源機２８の熱源側計測制御装置３１が他の制御装置からの情報を得られない、あるいは送信した情報の受信通知を得られないなど通信異常を検知した場合には、圧縮機１の運転を停止させるなどして熱源機２８の保護を行う。また、熱源機２８の熱源側計測制御装置１５、鉱油回収装置３１の洗浄側計測制御装置３３、運転制御装置３６の少なくともいずれか１つに通信異常が認められる場合は、各制御装置の少なくとも１つに通信異常状態であることを表示させ、配管洗浄運転を監視する監視者に知らしめ、監視者が熱源機２８の計測制御装置１５に予め設けられた圧縮機１の手動停止機能を作動させて圧縮機１を停止しても良い。このように、熱源機２８の熱源側計測制御装置１５と鉱油回収装置３１の洗浄側計測制御装置３３、運転制御装置３６の間で情報の伝達がうまく行われない場合は、熱源機２８の圧縮機１を速やかに停止し、熱源機２８の異常運転による熱源機２８の破損を防止することで、より信頼性の高い配管洗浄運転を実施することが可能となる。

【００９７】また、図２２、図２３に示すような形態で配管洗浄運転を実施した場合、熱源機２８の熱源側計測制御装置１５、鉱油回収装置３１の洗浄側計測制御装置３３、運転制御装置３６の少なくとも１つに、配管洗浄運転中の運転状況、例えば運転中に計測される圧力や温度などの冷媒の情報、圧縮機１の運転など各アクチュエータの運転情報、今までの洗浄時間や今後必要な洗浄時間、配管洗浄運転の完了または未完了など配管洗浄運転の進行状況を表示部に表示すると共に、記憶手段を用いて記録させてもよい。このような表示を行うことで配管洗浄運転中の運転状況を確認でき、配管洗浄運転の利便性が高まるとともに、配管洗浄運転の監視者がこの運転状況を監視し、配管洗浄運転が正常に行われていないと判断できるときには、配管洗浄運転を再度やり直す、あるいは配管洗浄運転の運転制御を適宜修正することで、配管洗浄運転を確実に行うことができる。また、配管洗浄運転の進行状況が記録されていることで、配管洗浄運転中に何らかの異常が発生し、運転が停止した場合など、運転状況の記録から運転停止の要因が明確になり、その要因の対策を行うことで、配管洗浄運転を確実に行うことが可能となる。また、配管洗浄運転がある程度進行したところで停止した場合には、運転状況の記録から残りの配管洗浄運転時間を導き出し、再開後の配管洗浄運転は残りの運転時間分を行うようにしてもよい。このような運転を行うことで、配管洗浄運転を再び初期から行うことに比べて必要十分な時間だけ配管洗浄を行うこととなり、必要以上の無駄な配管洗浄運転を行うことなく配管洗浄作業の時間を短縮できる。

【００９８】また、図２２、図２３に示すような形態をとる場合に、熱源機２８の熱源側計測制御装置１５に配管洗浄運転の完了または未完了を記録し、配管洗浄運転が完了となっていない場合は、熱源機２８において、通常時の運転など配管洗浄運転以外の運転を禁止するようにしてもよい。配管洗浄運転を実施するように熱源機２８、鉱油回収装置３１を構成しても、人為的ミスなど何らかの原因で配管洗浄運転が実施されない、または完了していない状態で配管洗浄運転を終了し、熱源機２８を用いて通常の冷凍空調装置としての運転を行う場合があり、この場合には、配管洗浄が完了していないので、既設配管中に残留する鉱油の流入により冷凍空調装置の運

転に不具合を来す場合がある。そこで熱源機２８を用いて通常の冷凍空調装置としての運転を行うなどの配管洗浄運転以外の運転を行う場合には熱源機２８の熱源側計測制御装置１５に配管洗浄運転の完了が必ず記録されているようにする。このようにすることで、通常の冷凍空調装置としての運転など、配管洗浄運転以外の運転を行う場合には確実に配管洗浄運転が完了しているようにすることができ、より信頼性の高い冷凍空調装置を供給することができる。

【００９９】実施の形態５．図２４、図２５は本発明の実施の形態５を示す図で、配管洗浄運転中、および洗浄運転終了後の熱源機運転中の情報の流れを示した図である。図２４、２５において、３４は冷凍空調装置とは遠隔された場所（例えば、冷凍空調装置管理業者のサービスセンター等）に設置されている集中管理装置であり、配管洗浄装置運転中、および洗浄運転終了後の熱源機運転中の運転情報を鉱油回収装置３１および熱源機２８の計測制御装置３３および１５から受け取る。図２５において、１３ｄ、１３ｅは利用側熱交換器２３での冷媒温度を検知する温度センサ、１３ｆは利用側熱交換器２３での室内空気温度を検知する温度センサ、３５は室内機２２の計測制御装置である。なお、図２４、２５のその他の符号は実施の形態１～４と同一であるので説明を省略する。

【０１００】図２５における室内機２２の計測制御装置は、冷凍空調装置使用者によって設定される設定温度や利用側熱交換器２３での冷媒温度、および室内空気温度の情報を熱源機２８の計測制御装置１５に伝送するとともに、熱源機２８の計測制御装置１５から伝送される情報をもとに利用側熱交換器２３の過熱度または過冷却度を演算し、その演算結果をもとに電子膨張弁２４の開度を決定したり、利用側熱交換器２３での熱交換量をファン風量などによって決定し、制御する。

【０１０１】また図２６は配管洗浄を伴う冷凍空調装置交換の際のサービス・メンテナンスの業務や情報の流れを表した図である。以下、サービス、情報の流れを図２６に基づいて説明する。まず最初に冷凍空調装置ユーザー４０が冷凍空調装置管理業者４１に冷凍空調装置４２の更新を依頼する（Ｓ１）。次に冷凍空調装置管理業者４１は、既存の冷凍空調装置及び既設配管の状況を調査し（Ｓ２）、既設配管が洗浄して使用可能と判断すれば、冷凍空調装置メーカー４３に冷凍空調装置を発注し（Ｓ３）、冷凍空調装置が納入される（Ｓ４）と工事業者４４に配管洗浄工事、冷凍空調装置の更新工事を依頼する（Ｓ５）。このとき図２３に示す鉱油回収装置３１については、冷凍空調装置メーカー４３から冷凍空調装置管理業者４１に販売され（Ｓ６）、冷凍空調装置管理業者４１がこの鉱油回収装置３１を用いた配管洗浄工事を工事業者４４に指示する。工事業者４４が冷凍装置設置工事を行い、配管洗浄を実施している間（Ｓ７）、配管洗浄運転中の熱源機２８、鉱油回収装置３１の運転情報は冷凍空調装置管理業者４１のもとにある図２３に示す集中管理装置３４に電話回線やインターネットによる有線通信や無線通信により伝送され（Ｓ８）、この集中管理装置３４を用いて、後述する配管洗浄運転中の熱源機２８、鉱油回収装置３１の管理がなされる（Ｓ９）。

【０１０２】そして配管洗浄後は、図２５に示すように熱源機２８を用いて通常の冷凍空調運転が実施されるが、このときの熱源機２８および室内機２２の運転情報も冷凍空調装置管理業者４１のもとにあるの集中管理装置３４に集められ（Ｓ８）、集中管理装置３４を用いて、通常運転中の熱源機２８の管理が行われる（Ｓ９）。配管洗浄運転及び通常運転中になんらかの不具合があり工事が必要な場合は、冷凍空調装置管理業者４１は、冷凍空調装置メーカー４３に保守部品を発注（Ｓ１０）するとともに、工事業者４４に保守工事を依頼し（Ｓ１１）、冷凍空調装置メーカー４３より保守部品が納入されると（Ｓ１２）、工事業者４４は保守工事を実施する（Ｓ１３）。

【０１０３】この実施の形態では図２４、図２５をもとに配管洗浄運転中、および配管洗浄運転後の熱源機２８の運転管理方法について説明する。まず図２４をもとに配管洗浄運転中の管理方法について説明する。この場合は、工事現場から遠隔設置された集中管理装置３４は、鉱油回収装置３１の計測制御装置３３から鉱油回収装置３１の運転情報を受け取ると共に、鉱油回収装置３１の計測制御装置３３を介して、熱源機２８の運転情報を受け取る。このとき受け取る情報としては、鉱油回収装置３１からは、被洗浄配管４の入口温度、高低圧熱交換器２５の熱交換量、電子膨張弁７の開度などの制御情報。そして熱源機２８からは、圧縮機１の吐出温度、吸入温度、および運転中の高圧圧力、低圧圧力、および圧縮機１の回転数、熱源側熱交換器３０のファン風量など機器の制御情報、および装置運転時の電気入力などの情報を受け取る。

【０１０４】次に集中管理装置３４では受け取った情報をもとに、配管洗浄運転が適切に行われているかを判断する。そして配管洗浄運転が適切に行われていないと判断されるときは、適切に運転を行うよう鉱油回収装置３１の計測制御装置３３に運転制御指示を与える。例えば、配管洗浄運転中の高圧圧力、低圧圧力、吐出温度、圧縮機吸入の過熱度、被洗浄配管４に流入する冷媒の乾き度について適切な目標値が設定されていない場合などには、上述の実施の形態１～４に示された配管洗浄の制御内容を指示する。また充填されている冷媒量に過不足があると判断されるときは、どの程度の冷媒量を追加チャージするか、または回収するかを判断し、冷凍空調装置の設置及び洗浄運転を実施している工事業者４４に連絡して冷媒の充填あるいは回収を指示する。また運転情報より、洗浄に必要な冷媒流量が不足しており、洗浄時

間を予定よりも多く要すると判断される場合は、必要な洗浄時間を決定し、その時間洗浄運転するように工事業者に指示する。このように、配管洗浄運転における運転情報を遠隔に設置された集中管理装置３４を使用し、管理業者４１が一元管理することで、一定の基準を持って情報に対応でき、確実に洗浄運転が実施できるようになり、工事業者の熟練度に依存しない配管洗浄が行なえるとともに配管洗浄の運転信頼性を向上させることができる。また、冷凍空調装置管理業者は遠隔の例えばサービスセンターから作業の指示ができるのでそれぞれの据え付け現場へ赴く手間が省け、配管洗浄の作業時間も削減できる効果がある。

【０１０５】次に図２５にもとづいて、配管洗浄後、熱源機２８で通常の冷凍空調運転を実施中の冷凍空調装置の管理方法について説明する。この場合集中管理装置３４は、熱源機２８の計測制御装置１５より熱源機２８の運転情報を受け取る。このとき受け取る情報としては、圧縮機１の吐出温度、吸入温度、および運転中の高圧圧力、低圧圧力、および圧縮機１の回転数、熱源側熱交換器３０のファン風量、および室内機の運転情報、すなわち、空調装置使用者によって設定される空調設定温度や利用側熱交換器２３での冷媒温度、室内空気温度、利用側熱交換器２３の熱交換量、および電子膨張弁２４の開度などの情報を受け取る。次に集中管理装置３４では受け取った情報をもとに、配管洗浄運転後に熱源機２８の運転が適切に行われているかを判断する。そして配管洗浄がうまくいっていないなどの理由で、熱源機２８の運転が適切に行われていないと判断されるときは、適切に運転を行うよう熱源機２８の計測制御装置１５に指示を与えたり、熱源機２８、室内機２２の修理を実施したりする。

【０１０６】例えば、室内機２２内の電子膨張弁２４の開度が全開になっているなど、大きく開いている状況において、低圧圧力が低下している、あるいは冷房運転時の利用側熱交換器２３の冷媒温度が想定される温度より低い、あるいは暖房運転時の利用側熱交換器２３の冷媒温度が想定される温度より高い、あるいは冷房運転時の利用側熱交換器２３の過熱度が想定される値より高い、あるいは暖房運転時の利用側熱交換器２３の過冷却度が想定される値より高いといった場合には電子膨張弁２４の一部が、配管洗浄時に洗浄できなかった残留物、あるいは設置工事の際に混入した異物などによって詰まっていると判断できる。

【０１０７】このような場合は集中管理装置３４は、まず電子膨張弁２４の開度がまだ開ける状況にある場合はさらに電子膨張弁２４の開度を開くように熱源機２８の計測制御装置１５に指示を出す一方で、電子膨張弁２４が不良である情報を冷凍空調装置管理業者４１に発する。冷凍空調装置管理業者４１はその情報をみて、電子膨張弁２４の交換を行うため、冷凍空調装置メーカー４３に交換部品を発注し、冷凍空調装置管理業者４１あるいは工事業者４４が電子膨張弁２４の交換を実施する。またこのときの不良の原因を調べるため、冷凍空調装置管理業者４１は、熱源機２８内の冷凍機油の性状を調査し、問題がある場合は冷凍機油交換などの対処作業を実施する。

【０１０８】また、熱源機２８の圧縮機１の電気入力が圧縮機の運転状況、すなわち高圧圧力、低圧圧力、回転数、吸入温度から予測される圧縮機１の入力値よりも大きくなっている場合には、圧縮機１の運転が不良になっていると判断できる。このような場合も冷凍空調装置管理業者４１は、熱源機２８内の冷凍機油の性状を調査し、問題がある場合は冷凍機油交換などの作業を実施する。また冷凍機油交換では対応できない場合などは、圧縮機１の交換などで対応する。

【０１０９】このように、配管洗浄後の冷凍空調装置運転においても、その運転情報を据え付け現場から遠隔設置された集中管理装置を用いて管理業者が一元に管理することで、一定の基準を持って情報に対応でき、確実に配管洗浄後の冷凍空調装置の運転が実施できるようになり、冷凍空調装置運転における信頼性を向上させることができる。

【０１１０】なお、上記の集中管理装置３４の機能を予め、鉱油回収装置３１の計測制御装置３３や熱源機２８の計測制御装置１５に組み込んで置いてもよい。この場合、洗浄運転中や通常運転中に対策が必要な事項がある場合には、計測制御装置１５、３３において異常信号が発せられ、この信号に応じて、冷凍空調装置管理業者４１や工事業者４４が保守の対策を実施し、発生した異常に対して迅速な対応ができ作業時間の短縮化が図られる。

【０１１１】

【発明の効果】本発明の請求項１に係わる配管洗浄装置は、圧縮機、凝縮器、膨張装置、蒸発器を接続し、前記圧縮機で搬送される冷媒によって被洗浄体を洗浄して被洗浄物を回収する回収装置と、前記冷媒の物理状態が予め定められた目標値となるように、前記凝縮器の熱交換能力、前記膨張装置の流動抵抗及び前記蒸発器の熱交換能力の少なくともいずれか１つを制御する制御装置とを備えたので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１１２】本発明の請求項２に係わる配管洗浄装置は、制御装置は被洗浄体に流入する冷媒が気液二相流となるように制御するので、配管洗浄能力を向上することができる。

【０１１３】本発明の請求項３に係わる配管洗浄装置は、圧縮機の吸入側配管に低圧圧力センサを備え、前記低圧圧力センサにより検知される低圧圧力が予め定められた所定目標値以上となるように制御装置を制御するので、洗浄能力を向上するとともに運転信頼性の高い配管

洗浄装置を提供することができる。

【０１１４】本発明の請求項４に係わる配管洗浄装置は、圧縮機の吐出側配管に高圧圧力センサを備え、前記高圧圧力センサにより検知される高圧圧力が予め定められた所定目標値以上となるように制御装置を制御するので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１１５】本発明の請求項５に係わる配管洗浄装置は、圧縮機の吐出側配管に吐出温度センサを備え、前記吐出温度センサにより検知される吐出温度が予め定められた所定目標値以下となるように制御装置を制御するので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１１６】本発明の請求項６に係わる配管洗浄装置は、圧縮機の吸入側配管に低圧圧力センサおよび吸入温度センサを備え、前記低圧圧力センサから検知される低圧圧力と前記吸入温度センサから検知される吸入温度により算出される吸入過熱度が予め定められた所定目標値となるように制御装置を制御するので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１１７】本発明の請求項７に係わる配管洗浄装置は、圧縮機の吐出側配管に高圧圧力センサと凝縮器の出口側配管に凝縮出口温度センサを備え、前記高圧圧力センサから検知される高圧圧力と前記凝縮出口温度センサから検知される凝縮器出口温度から算出される二相冷媒の乾き度が予め定められた所定目標範囲となるように制御装置を制御するので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１１８】本発明の請求項８に係わる配管洗浄装置は、凝縮器で得られる冷媒の凝縮熱の一部または全部を蒸発器における蒸発熱として熱交換する高低圧熱交換器を設けたので、配管洗浄装置をコンパクトにできる。

【０１１９】本発明の請求項９に係わる配管洗浄装置は、冷媒の物理状態が予め定められた目標値となるように、高低圧熱交換器の熱交換量を変化させるので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１２０】本発明の請求項１０に係わる配管洗浄装置は、高低圧熱交換器から流出する蒸発した冷媒を冷却するガス冷却手段を備え、前記ガス冷却手段の冷却能力を冷媒の物理状態に応じて変化させるので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１２１】本発明の請求項１１に係わる配管洗浄装置は、圧縮機の運転能力が可変であるので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１２２】本発明の請求項１２に係わる配管洗浄装置は、圧縮機の運転能力に応じて冷媒の物理状態の制御目標値を決めるので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１２３】本発明の請求項１３に係わる配管洗浄装置は、被洗浄体の流動抵抗に応じて冷媒の物理状態の制御目標値を決めるので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１２４】本発明の請求項１４に係わる配管洗浄装置は、配管洗浄装置の周囲温度に応じて冷媒の物理状態の制御目標値を決めるので、洗浄能力を向上するとともに運転信頼性の高い配管洗浄装置を提供することができる。

【０１２５】本発明の請求項１５に係わる配管洗浄装置は、圧縮機を有する熱源機と被洗浄配管の間に接続される配管洗浄装置において、前記熱源機または前記配管洗浄装置の少なくともどちらか一方に前記圧縮機から吐出された冷媒を凝縮させる熱交換器を備えると共に、前記配管洗浄装置に、前記熱交換器により凝縮された冷媒を減圧させる膨張装置と、前記被洗浄配管を流通した冷媒から被洗浄物を分離回収する被洗浄物回収手段と、前記熱源機が有する熱源側制御装置から運転情報を伝送可能とする洗浄側制御装置とを備えたので、もともと配管洗浄を考慮されていない熱源機でも大きな制御変更を伴うことなく配管洗浄運転ができ、この熱源機適用の幅を広げ、汎用性を高めることができる。

【０１２６】本発明の請求項１６に係わる配管洗浄装置は、洗浄側制御装置が熱源機の運転状態に応じて熱交換器の熱交換量または膨張装置の絞り量または圧縮機の運転容量のうち少なくともいずれか１つを制御するので、洗浄能力を向上することができる。

【０１２７】本発明の請求項１７に係わる配管洗浄装置は、圧縮機と外部に配設した運転制御装置に運転情報を伝送可能とする熱源側制御装置を有する熱源機と被洗浄配管の間に接続される配管洗浄装置において、熱源機または配管洗浄装置の少なくともどちらか一方に圧縮機から吐出された冷媒を凝縮させる熱交換器を備えると共に、配管洗浄装置に、熱交換器により凝縮された冷媒を減圧させる膨張装置と、被洗浄配管を流通した冷媒から被洗浄物を分離回収する被洗浄物回収手段と、熱源側制御装置または／および運転制御装置の間で運転情報を伝送可能にする洗浄側制御装置とを備えたので、もともと配管洗浄を考慮されていない熱源機でも大きな制御変更を伴うことなく配管洗浄運転ができ、この熱源機適用の幅を広げ、汎用性を高めることができるとともに、配管洗浄装置においても熱源機に対応した大きな制御変更を伴うことなく配管洗浄運転ができ、この熱源機適用の幅を広げ、汎用性を高めることができる。

【０１２８】本発明の請求項１８に係わる配管洗浄装置は、運転制御装置が熱源機および配管洗浄装置の運転状態に応じて熱交換器の熱交換量または膨張装置の絞り量または圧縮機の運転容量のうち少なくともいずれか１つ

を制御するので、洗浄能力を向上することができる。

【０１２９】本発明の請求項１９に係わる配管洗浄装置は、熱源機が有した熱源側制御装置と配管洗浄装置が有した制御装置の間、あるいは外部に配設した運転制御装置と前記熱源側制御装置と前記洗浄側制御装置との間における運転情報の伝送に不具合が発生したときに、前記熱源機に配設された圧縮機の運転を停止する機能を熱源側制御装置に備えたので、配管洗浄運転中の異常運転による熱源機破損を防止でき、信頼性の高い冷凍空調装置を得ることができる。

【０１３０】本発明の請求項２０に係わる配管洗浄装置は、熱源側制御装置、洗浄側制御装置または運転制御装置の少なくともいずれか１つに配管洗浄運転の進行状況を記録する記憶手段もしくは表示する表示手段を備えたので、配管洗浄運転中に運転状況を確認でき配管洗浄運転の利便性が高まるとともに、配管洗浄運転が十分に実施できない場合の対応が容易になりより確実に配管洗浄運転を行うことができる。

【０１３１】本発明の請求項２１に係わる配管洗浄装置は、熱源側制御装置、洗浄側制御装置または運転制御装置の少なくともいずれか１つに有した記憶手段に配管洗浄運転の完了もしくは未完了を記録するので、配管洗浄運転の運転状況を確認でき配管洗浄運転の利便性を高めることができる。

【０１３２】本発明の請求項２２に係わる配管洗浄装置は、配管洗浄運転が未完了で中断した場合に、配管洗浄運転の進行状況の記録をもとに配管洗浄運転を再開する機能を洗浄側制御装置または運転制御装置の少なくともどちらか一方に保持するので、配管洗浄運転の運転時間を必要十分な長さ実施することが可能となり、配管洗浄運転を適切に実施することが可能となる。

【０１３３】本発明の請求項２３に係わる配管洗浄装置は、熱源側制御装置に配管洗浄運転の完了記録がなされていない場合、熱源機において配管洗浄運転以外の運転を禁止するので、配管洗浄運転未完了時に、通常運転などの既設配管を用いた運転を行うことが無くなり、信頼性の高い冷凍空調装置を得ることができる。

【０１３４】本発明の請求項２４に係わる配管洗浄方法は、既設使用の冷凍空調装置を既設配管から取り除くステップと、前記既設配管に配管洗浄装置を取り付けるステップと、前記配管洗浄装置により配管洗浄運転を行なうステップと、前記配管洗浄装置に設けた制御装置から遠隔設置された集中管理装置へ伝送される前記配管洗浄装置の運転状態の情報をもとに前記配管洗浄運転の適性を判断するステップとを備えたので、配管洗浄運転における運転情報を一元に管理して一定の基準で対応することができ、配管洗浄作業の熟練度に依存しない信頼性の高い冷凍空調装置を得ることができる。

【０１３５】本発明の請求項２５に係わる配管洗浄方法は、配管洗浄運転の適性判定により、運転制御条件または冷媒量調整の変更を行なうステップを備えたので、冷凍空調装置管理業者の手間や配管洗浄作業時間の削減の効果が得られる。

【図面の簡単な説明】

【図１】　本発明の実施の形態１に係る配管洗浄装置の冷媒回路図である。

【図２】　本発明の実施の形態１に係る鉱油の配管残存量と洗浄時間の関係を示す図である。

【図３】　本発明の実施の形態１に係る圧縮機の冷媒流量と圧縮機回転数の関係を示す図である。

【図４】　本発明の実施の形態１に係る冷媒の乾き度と温度の関係を示す図である。

【図５】　本発明の実施の形態１に係る凝縮器、蒸発器の他の形態を示す図である。

【図６】　本発明の実施の形態１に係る凝縮器、蒸発器の他の形態を示す図である。

【図７】　本発明の実施の形態１に係る配管洗浄装置と凝縮器の構成を示す断面図である。

【図８】　本発明の実施の形態１に係る配管洗浄装置における覆いの設置方法を示す図である。

【図９】　本発明の実施の形態１に係る配管洗浄装置における覆いの設置方法の他の例を示す図である。

【図１０】　本発明の実施の形態１に係る配管洗浄装置における覆いの設置方法の他の例を示す図である。

【図１１】　本発明の実施の形態１に係る電子膨張弁を利用した他の形態を示す図である。

【図１２】　本発明の実施の形態１に係る配管洗浄装置の他の形態を示す冷媒回路図である。

【図１３】　本発明の実施の形態２を示す配管洗浄装置の冷媒回路図である。

【図１４】　本発明の実施の形態２における高低圧熱交換器の形態を示す図である。

【図１５】　本発明の実施の形態２における配管洗浄装置の運転状況を示す図である。

【図１６】　本発明の実施の形態２における配管洗浄装置の高低圧熱交換器の熱交換量変化時の運転状況を示す図である。

【図１７】　本発明の実施の形態２における配管洗浄装置の外気温変化時の運転状況を示す図である。

【図１８】　本発明の実施の形態２における高低圧熱交換器の他の形態を示す図である。

【図１９】　本発明の実施の形態３を示す配管洗浄装置の冷媒回路図である。

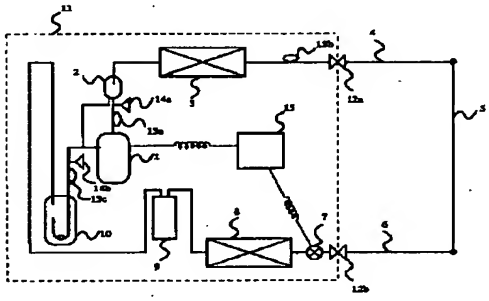
【図２０】　本発明の実施の形態３における配管洗浄装置の運転状況を示す図である。

【図２１】　本発明の実施の形態３における配管洗浄装置のガス冷却器ファン風量変化時の運転状況を示す図である。

【図２２】　本発明の実施の形態４を示す配管洗浄装置の冷媒回路図である。

【図２３】　本発明の実施の形態４における別の配管洗浄装置の冷媒回路図である。
【図２４】　本発明の実施の形態５を示す配管洗浄装置の冷媒回路図である。
【図２５】　本発明の実施の形態５に係わる冷凍空調装置の冷媒回路図である。
【図２６】　本発明の実施の形態５に冷凍空調装置更新時のサービス内容を示す図である。
【図２７】　従来の冷凍空調装置の冷媒回路図である。
【図２８】　従来の冷凍機油（鉱油）混入時のＨＦＣ用冷凍機油とHFC冷媒との溶解性を示す臨界溶解度曲線の関係線図である。
【符号の説明】
１　圧縮機、２　油分離器、３　凝縮器、４、６　配管（既設配管、接続配管、被洗浄配管）、５　バイパス管、７　電子膨張弁、８　蒸発器、９　分離回収装置、１０　アキュムレータ、１０ａ　返油穴、１１　配管洗浄装置、１２ａ，１２ｂ，１２ｃ，１２ｄ，１２ｅ，１２ｆ　接続弁、１３ａ，１３ｂ，１３ｃ，１３ｄ，１３ｅ　温度センサ、１４ａ，１４ｂ　圧力センサ、１５　計測制御装置、１６　弁、１７　バイパス配管、１８　外気吸込口、１９　外気吹出口、２０　覆い、２１　風路、２２　室内機、２３　利用側熱交換器、２４　電子膨張弁、２５　高低圧熱交換器、２６　二重管、２７　ガス冷却器、２８　熱源機、２９　四方弁、３０　熱源側熱交換器、３１　鉱油回収装置、３２ａ，３２ｂ，３２ｃ，３２ｄ　逆止弁、３３　（洗浄側）計測制御装置、３４　集中管理装置、３５　（熱源側）計測制御装置、３６　運転制御装置。

【図１】



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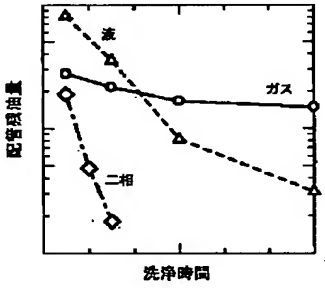

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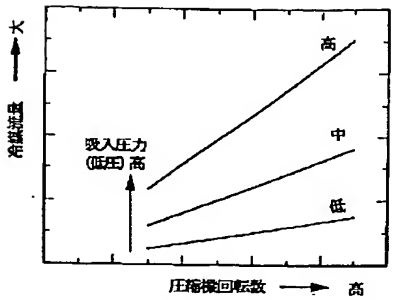

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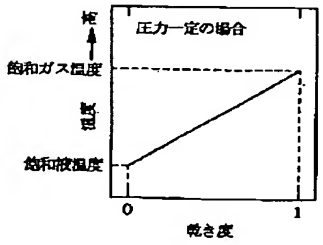

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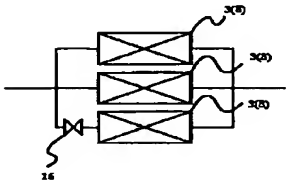

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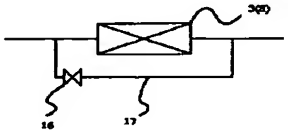

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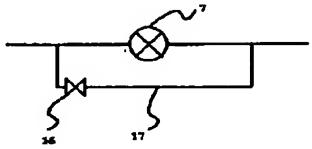

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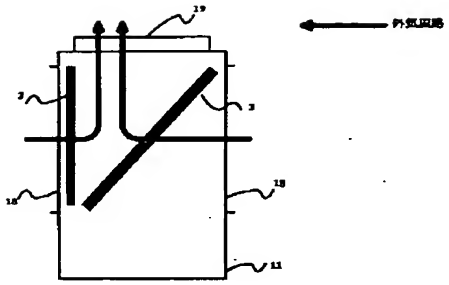

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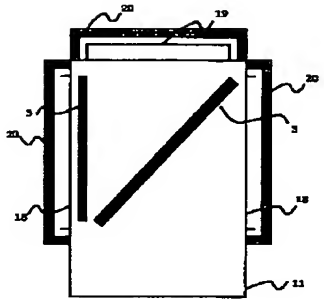

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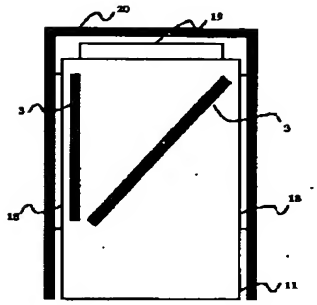

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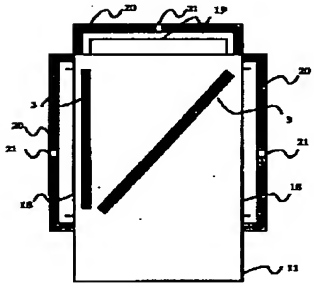

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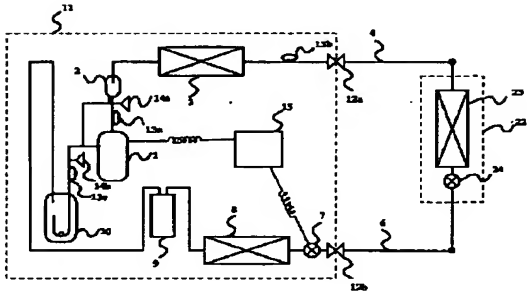

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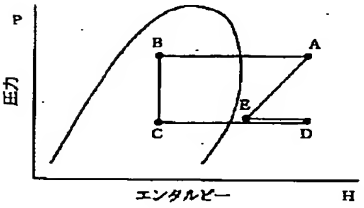

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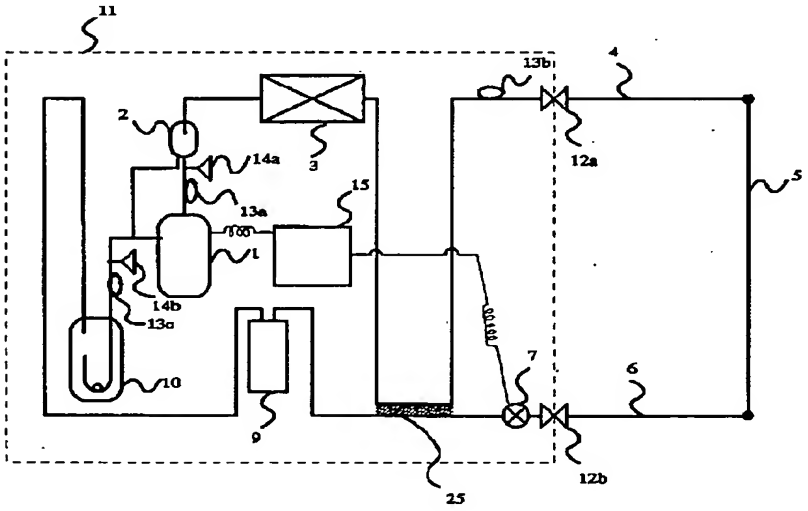

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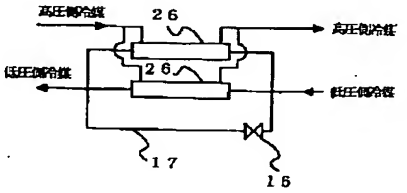

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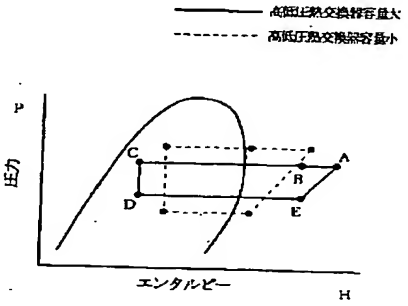

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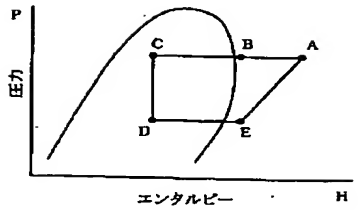

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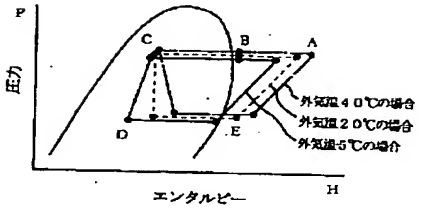

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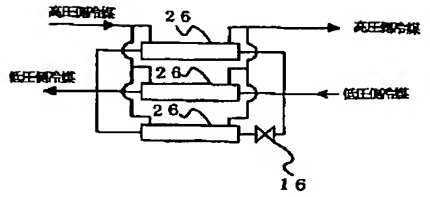

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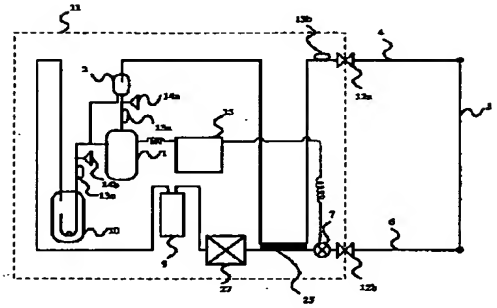

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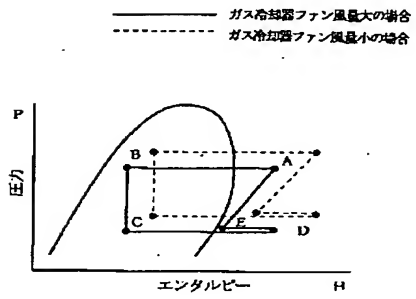

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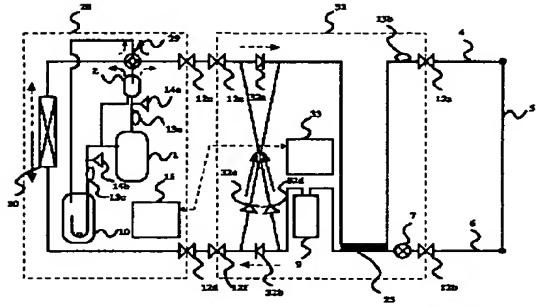

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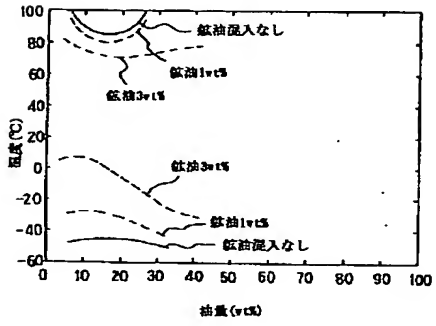

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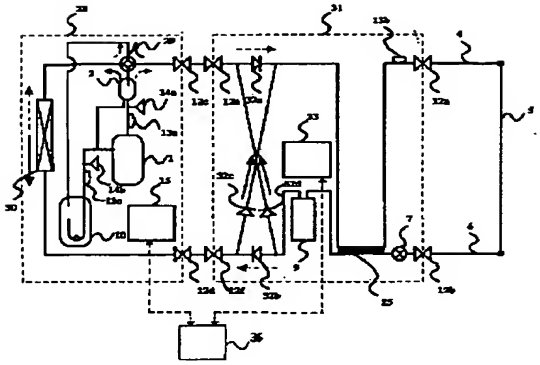

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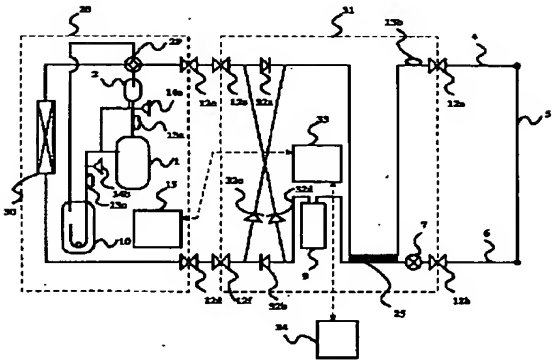

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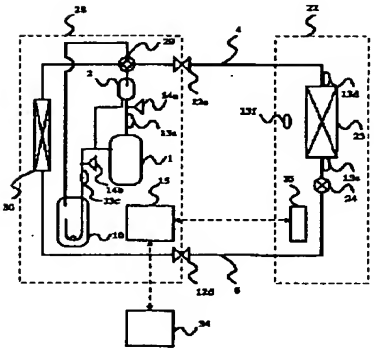

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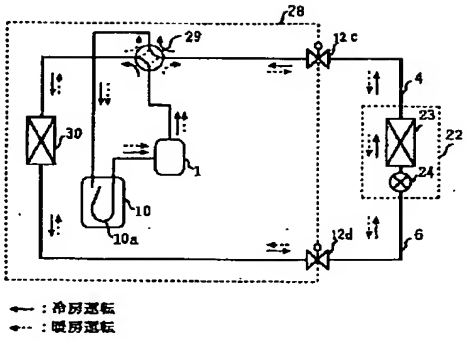

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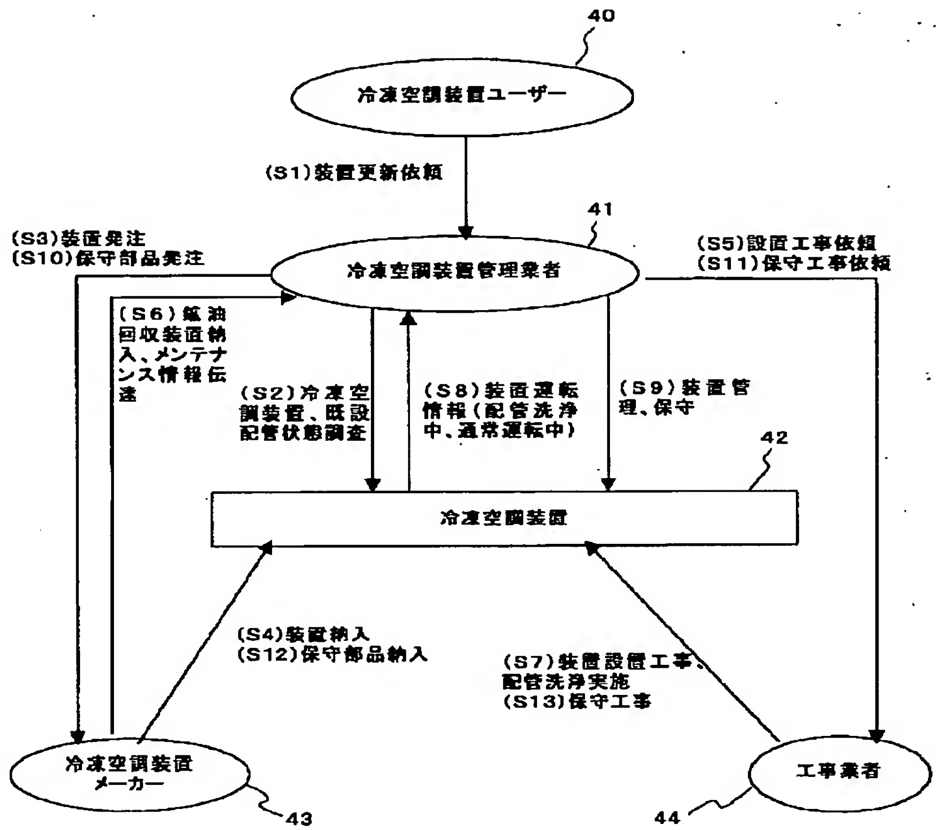

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CD41 CD43
3H045 AA09 AA12 AA27 BA00 CA02
CA29 DA05 EA34 EA42